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NAVSHIPS 92021

INSTRUCTION BOOK

for

RADIO RECEIVING SET AN/FRR-27

CONSISTING OF

RADIO RECEIVER R518/FRR-27 AND ACCESSORIES

DEPARTMENT OF THE NAVY

BUREAU OF SHIPS

NAVSHIPS 92021

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RADIO RECEIVER R518/FRR-27 AND ACCESSORIES

COMMUNICATIONS COMPANY, INC.
CORAL GABLES, FLORIDA

BUREAU OF SHIPS NAVY DEPARTMENT

Contract NObsr 52715 *Approved by BuShips: 17 August 1953*

LIST OF EFFECTIVE PAGES

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DEPARTMENT OF THE NAVY
BUREAU OF SHIPS
WASHINGTON 25, D. C.

IN REPLY REFER TO
Code 993-100
17 August 1953

From: Chief, Bureau of Ships
To: All Activities Concerned with the Installation, Operation and Maintenance of the Subject Equipment

Subj: Instruction Book for Radio Receiving Set AN/FRR-27 NAVSHIPS 92021

1. This is the instruction book for the subject equipment and is in effect upon receipt.

2. When superseded by a later edition, this publication shall be destroyed.

3. Extracts from this publication may be made to facilitate the preparation of other Department of Defense Publications.

4. All Navy requests for NAVSHIPS Electronics publications should be directed to the nearest District Publications and Printing Office. When changes or revised books are distributed, notice will be included in the Bureau of Ships Journal and in the Index of Bureau of Ships Journal and Electronics Publications, NAVSHIPS 250-020.

W. D. LEGGETT, JR.
Chief of Bureau

RECORD OF CORRECTIONS MADE

CHANGE NO.	DATE	SIGNATURE OF OFFICER MAKING CORRECTIONS

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INSTALLATION RECORD

Contract Number Nobrs-52715 Date of Contract, June 29, 1951

Serial Number of Equipment.....

Date of Acceptance by the Navy.....

Date of Delivery to Contract Destination.....

Date of Completion of Installation.....

Date Placed in Service.....

ORDERING PARTS

All requests for replacement material should include the following data:

1. Standard Navy Stock Number or, when ordering from a Marine Corps or Signal Corps supply depot, the Signal Corps stock number.
2. Name and short description of part.

If the appropriate Standard Navy Stock Number is not available, the following shall be specified:

1. Equipment model or type designation, circuit symbol, and item number.
2. Name of part and complete description.
3. Manufacturer's designation.
4. Contractor's drawing and part number.
5. JAN or Navy type number.

SAFETY NOTICE

The attention of officers and operating personnel is directed to Chapter 67 of Bureau of Ships Manual or superseding instructions on the subject of "Radio-Safety Precautions to be Observed."

This equipment employs voltages which are dangerous, and which may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

While every practical safety precaution has been incorporated in this equipment the following rules must be strictly observed:

KEEP AWAY FROM LIVE CIRCUITS:

Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside equipment with high voltage supply on. Under certain conditions dangerous potential may exist in circuits with power controls in the off position due to charges retained by capacitors. To avoid casualties always remove power and discharge and ground circuits prior to touching them.

DON'T SERVICE OR ADJUST ALONE:

Under no circumstances should any person reach within or enter the enclosure for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

DON'T TAMPER WITH INTERLOCKS:

Do not depend upon door switches or interlocks for protection but always shut down motor generators or other equipment. Under no circumstances should any access gate, door or safety interlock switch be removed, short circuited, or tampered with in any way, by other than authorized maintenance personnel, nor should reliance be placed upon the interlock switches for removing voltages from the equipment.

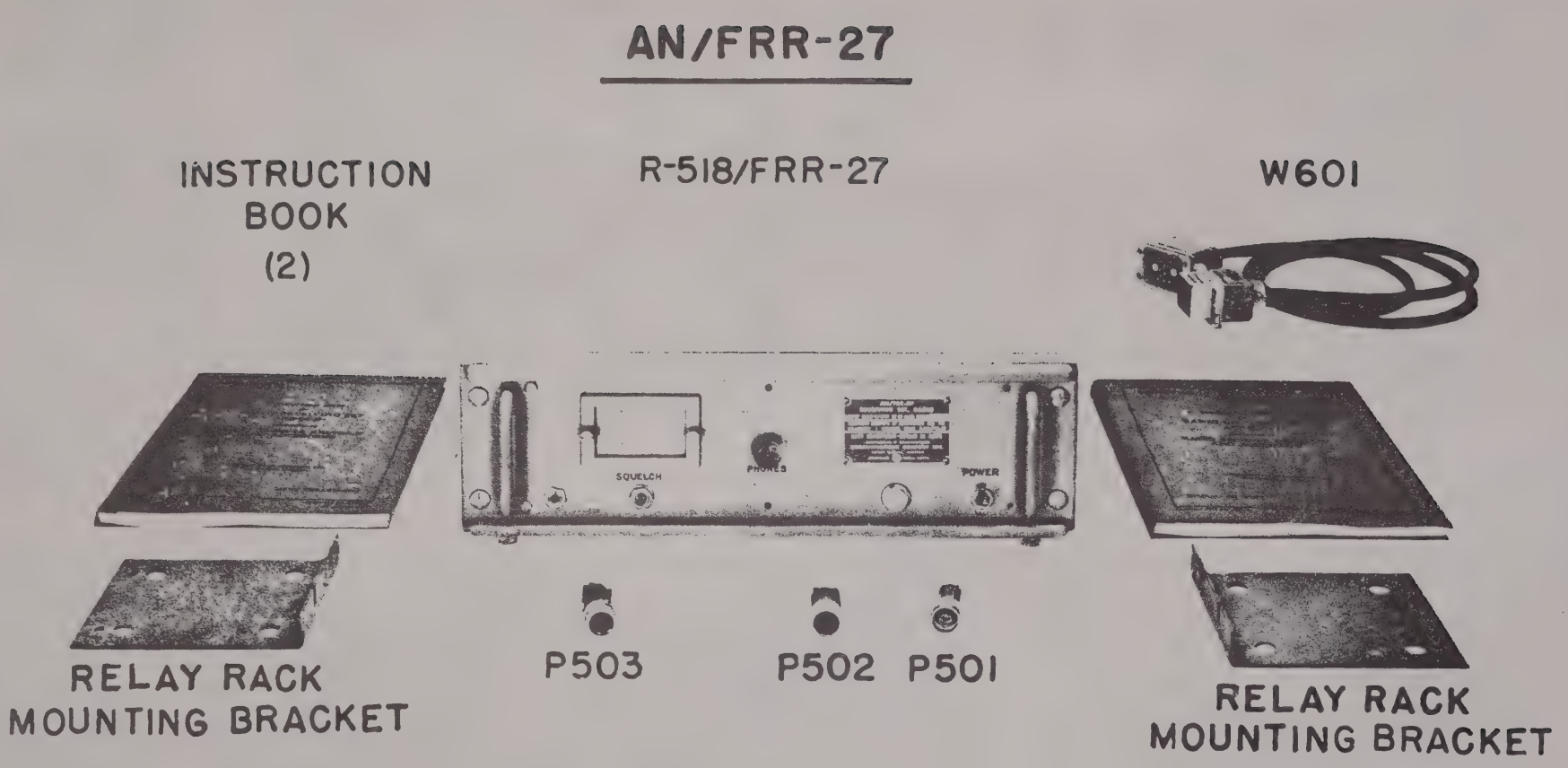


Figure 1-1. Radio Receiving Set AN/FRR-27 Complete, Including Radio Receiver R-518/FRR-27, Brackets, Plugs, Test Cable, and Instruction Books

SECTION 1
GENERAL DESCRIPTION

1. INTRODUCTION.

This instruction book describes the circuit theory, installation, operation, and maintenance of Radio Receiving Set AN/FRR-27.

2. DESCRIPTION.

a. PURPOSE.—Radio Receiving Set AN/FRR-27 is designed to provide means for reception of amplitude modulated (A3) voice and tone (A2) transmission in the 100-156 Mc frequency range for use in air traffic control towers at Naval Air Stations. The receiver can also be used at Naval Shore stations or advanced bases on point-to-point communication circuits.

b. BASIC PRINCIPLES OF OPERATION.—Radio Receiving Set AN/FRR-27 is a VHF, double conversion superheterodyne receiver, designed for single-channel, crystal-controlled operation over a frequency range of 100-156 Mc. By employing a suitable crystal, any channel within the frequency range of the receiver can be selected. Individual coil and transformers provide high selectivity, which results in a bandwidth of 82 kc at the 6 db points. The receiver has an over-all sensitivity of approximately 2 to 8 microvolts for a 10 db signal-to-noise ratio. The frequency determining crystal, beating with the incoming signal produces the first IF of 23 Mc. This 23 Mc signal is mixed with the 20 Mc crystal oscillator output to obtain the second IF of 3 Mc.

Automatic gain control is applied to the RF amplifier, first IF amplifier and second IF amplifier to assure a constant audio output level. A noise limiter circuit permits rejection of a large part of any impulse noise received with signals, and may be switched on or off. An adjustable squelch circuit provides quieting of the receiver noise during periods when no signal is being received. The squelch opening threshold may be set at any point within the receiver input range of 1 to 100 microvolts.

A three stage audio amplifier, which utilizes inverse feedback and a separate output tube, provides audio output in excess of 1.5 watts with less than 7 per cent distortion. Audio frequency response is flat within 2 db over the range of 300 to 3500 cycles, with a sharp cutoff above and below this range. The use of degeneration permits the use of varying loads between 200 and 600 ohms, without noticeable loss of output. Primarily designed for local operation, the equipment may also be used with remote speakers. Monitoring of the audio signals is available through a front panel jack.

All power necessary for operation of the equipment is obtained from an integral selenium rectifier power supply which operates from a 105, 115, or 125 volt, 50-60 cycle, single-phase source. All audio and power lines are filtered to limit radio frequency interference.

c. EQUIPMENT ARRANGEMENT.—Radio Receiving Set AN/FRR-27 is shown complete in figure 1-1. It consists of the receiver proper (Radio Receiver R-518/FRR-27); a pair of auxiliary angle brackets for relay rack mounting; a set of four mounting legs for table or bench mounting (shown already mounted in place in figure 1-1); a test cable, W601, for connecting the receiver chassis with the case and rear compartment panel during alignment; 3 plugs for use in fabricating external cables to the receiver; and two copies of the instruction book.

The receiver proper is designed to permit standardization of case and chassis dimensions with other receiver models, and is fabricated to utilize plug-in assemblies. It consists of a case, at the rear of which is mounted the rear compartment; the chassis front panel-frame assembly which functions as a framework into which three plug-in sub-chassis assemblies are mounted. The three plug-in sub-chassis assemblies are wired complete as functional units, and connect to the front panel shelf through self-aligning connectors. The equipment may be mounted on a bench or other firm horizontal surface, or (by attaching brackets) on a standard 19-inch relay rack.

The three plug-in assemblies, which are designated as the RF sub-chassis assembly, the IF sub-chassis assembly, and the Audio-Power Supply sub-chassis assembly, perform basically the functions of their titles. Operating controls are mounted on the front panel; circuit adjustment controls are on the RF, IF, and Audio-Power Supply sub-chassis assemblies. All external connections, including the antenna transmission line, are brought into the receiver Audio-Power Supply sub-chassis through the rear compartment. The antenna is connected from the Audio/Power Supply to the RF sub-chassis by a short coaxial cable and bayonet-locking connector.

Receiver alignment is possible by means of special intermediate frequency transformer tuning slugs which are accessible from the top and bottom of shield cans,

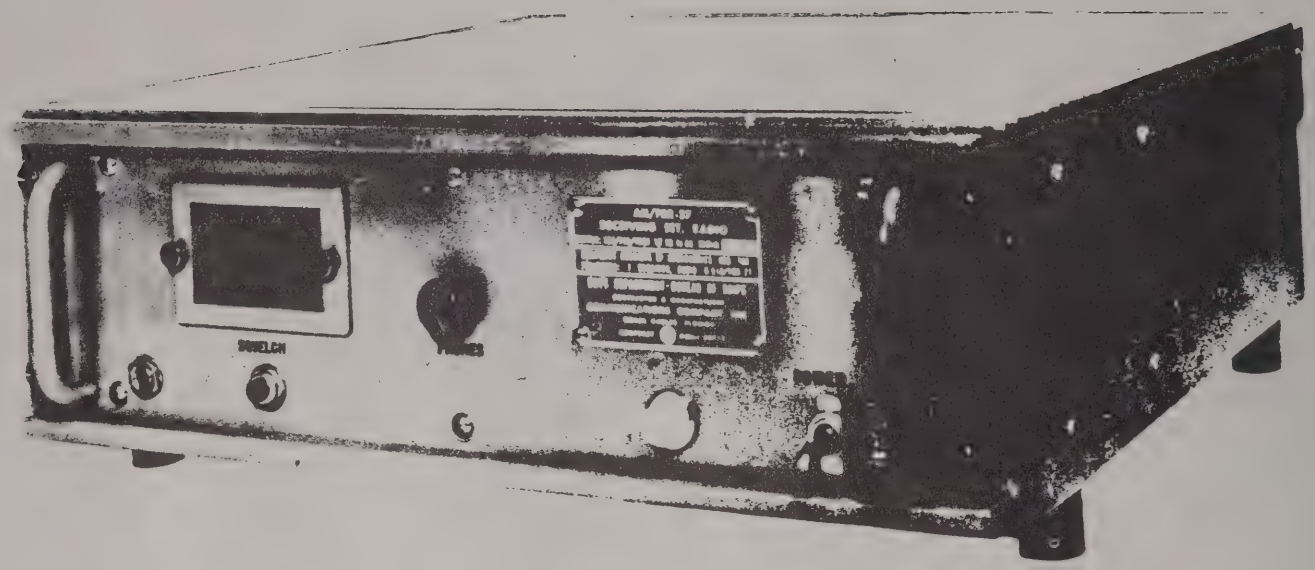


Figure 1-2. AN/FRR-27 Radio Receiver, Front Panel and Side

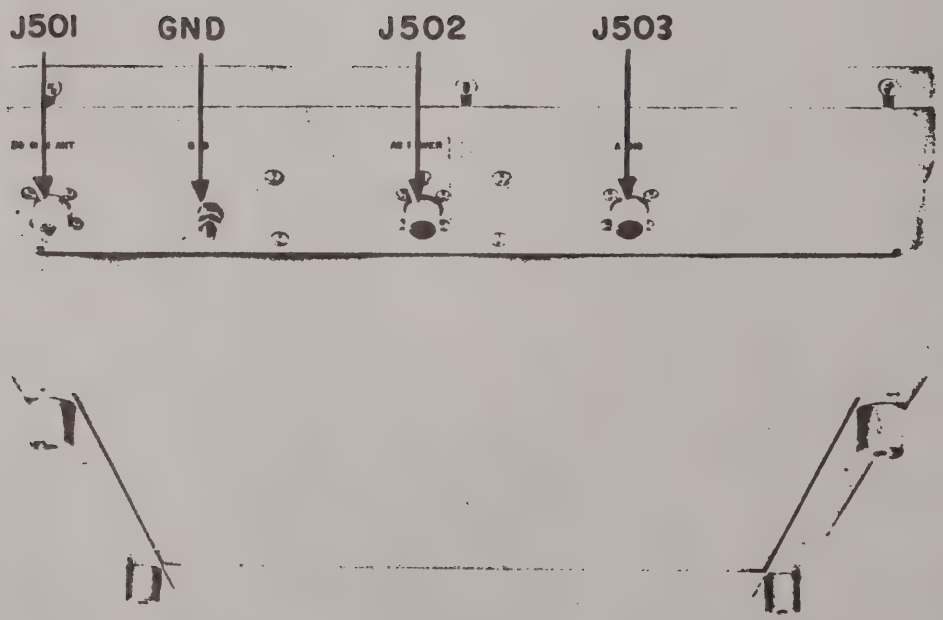


Figure 1-3. Bottom-Rear View, Radio Receiver, Showing Rear Compartment with Connector Receptacles

top tuning radio frequency transformers and test points. A special test cable, W601, is supplied with the receiving equipment to permit operation of the receiver chassis outside the case and rear compartment by providing connections between the two units.

The equipment is supplied with a full complement of tubes and fuses installed. The tube complement is summarized in table 1-4.

TABLE 1-1. EQUIPMENT SUPPLIED

QUAN. PER EQUIP.	NAME OF UNIT	NAVY TYPE DESIGNATION	OVERALL DIMENSIONS—INCHES			VOLUME CUBIC INCHES	WEIGHT (LBS)
			HEIGHT	WIDTH	DEPTH		
1	Radio Receiver, including: 1 set of three plugs for external cords (packed in a box) and 1 pair relay rack mounting brackets	R-518/FRR-27 (See table 3-2) (See figure 3-2)	6 3-1/2 5-1/4	17 3-1/2 6	18-3/4 1 1	1912-1/2 12-1/4 —	35 lb 8 oz. 3 oz 9 oz.
1	Test cable	W601 (See figure 7-2)	3-1/2	3-1/2	12	147	1 lb, 5 oz
2	Instruction books	Navships 92021	11-1/2	8-3/4	1/2	50	1 lb, 15oz

TABLE 1-2. EQUIPMENT REQUIRED BUT NOT SUPPLIED

QUAN. PER EQUIP.	NAME OF UNIT	NAVY TYPE DESIGNATION	REQUIRED USE	REQUIRED CHARACTERISTICS
1	Antenna	See applicable installation drawing	Signal pickup	50 ohm impedance at the signal frequency
As required	Antenna transmission line	See applicable installation drawing	Antenna to receiver connection	50 ohm surge impedance; coaxial
1 each channel	Crystal units	JAN type CR-23/U	Crystal control of tuning	Crystal frequency computation (See SECTION 7, para. 4.g.)
As required	Power cable	See applicable installation drawing	Power input from 50-60 cps, 105, 115 or 125 v AC power source	2 wires, #18 or larger
As required	Audio Output cable(s)	See applicable installation drawing	Audio output connection to speaker(s) headphones or other audio responsive devices	Twisted shielded pair
1	Headphones, with cord and plug	Navy Type 49016	Listening	600 ohms impedance
1	Loudspeakers or other audio responsive devices	See applicable installation drawing	Listening	200 to 600 ohm impedance

TABLE 1-3. SHIPPING DATA

SHIPPING CASE NUMBER	CONTENTS		OVERALL DIMENSIONS (INCHES)			VOLUME (CUBIC INCHES)	WEIGHT POUNDS
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
1	Radio Receiving Set	AN/FRR-27	12	23	26-1/2	7250	84

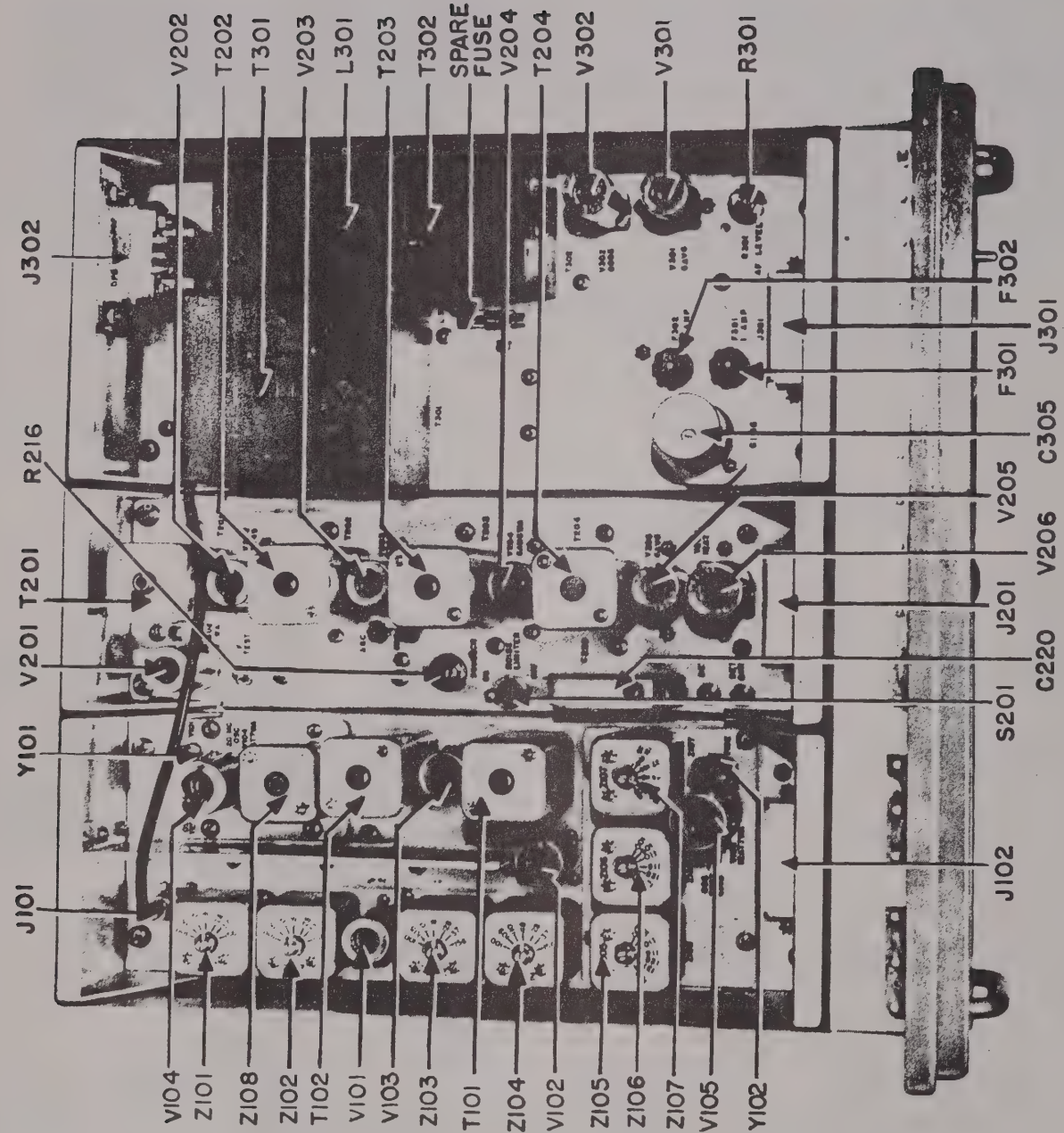


Figure 1-4. Radio Receiver Chassis, Top View

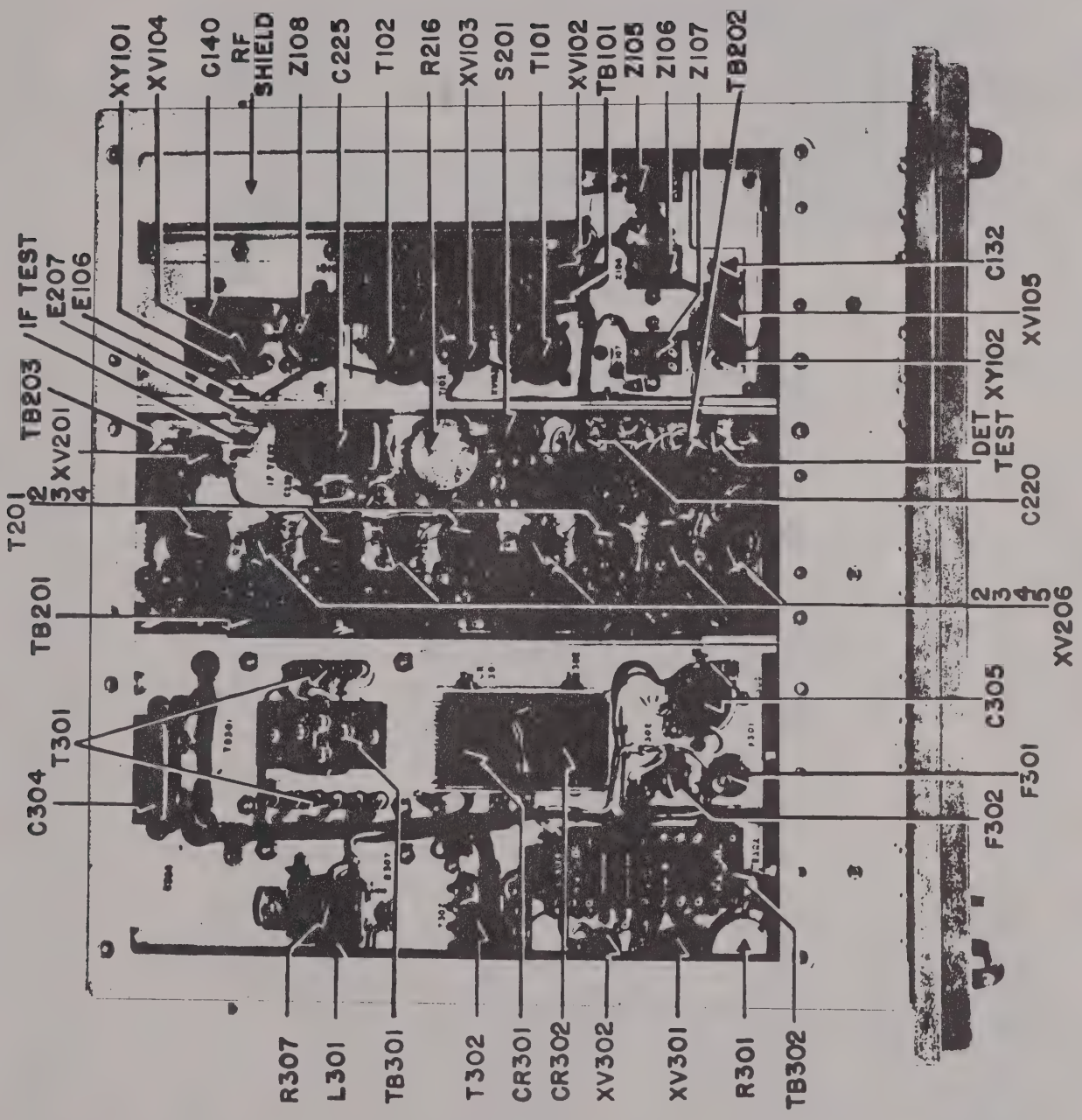


Figure 1-5. Radio Receiver Chassis, Bottom View

TABLE 1-4. ELECTRON TUBE COMPLEMENT

CIRCUIT	CIRCUIT SYMBOL	QUANTITIES OF TUBES USED					
		5654	6AU6 WA	6201/ 12AT7WA	5749	6AV6	6005/ 6AQ5W
RF SUB-CHASSIS ASSEMBLY							
RF Amplifier	V101	1					
First Mixer	V102	1					
23 Mc IF Amplifier	V103				1		
20 Mc Oscillator	V104			1			
Frequency Determining Oscillator/Multiplier	V105			1			
IF SUB-CHASSIS ASSEMBLY							
Second Mixer	V201		1				
First 3 Mc IF Amplifier	V202				1		
Second 3 Mc IF Amplifier	V203				1		
Third 3 Mc IF Amplifier	V204		1				
Detector Diode	V205					1/4	
AGC Diode	V205					1/4	
Squelch (Silencer)	V205					1/2	
Noise Limiter	V206A			1/2			
First Audio Amplifier	V206B			1/2			
AUDIO/POWER SUPPLY SUB-CHASSIS ASSEMBLY							
Second Audio Amplifier	V301					1	
Audio Output	V302						1

3. DESCRIPTION OF MAJOR SUB-ASSEMBLIES.

a. CABINET.—Figure 1-6 is a view into the cabinet with the receiver chassis removed. It is fabricated from aluminum alloy and finished in a gray enamel. Guide rails, located at the bottom of the cabinet facilitate removal and replacement of the receiver chassis assembly. When installed in a standard relay rack, the four mounting feet are removed, and the two angle brackets are attached to the sides of the cabinet. Spring-acting side latches on each side of the case permit the receiver chassis to be withdrawn to a point where most of the top chassis components are accessible with the chassis still supported. When it is necessary to remove the chassis from the cabinet, the two latch levers are pressed down, at the same time pulling out on the chassis (see figure 5-2). The receptacle connector (J504) which is visible at the right rear of the case interior is so located that, when the receiver chassis is placed in the cabinet, the receptacle mates with a corresponding connector on the receiver Audio-Power Supply sub-chassis.

b. FRONT PANEL—FRAME ASSEMBLY.—Figures 1-2 and 1-7 show this assembly. The panel mounts two handles, which are used to pull the receiver chassis from the case and for carrying purposes. Across the top and bottom of the panel are mounted bars which provide a recess arrangement, designed to minimize accidental movement of the panel controls. The panel and case are finished in the same gray enamel. The panel mounts a card holder for the frequency chart card and an identification plate. Four Simmons fasteners, one on each corner of the front panel, lock the receiver chassis in place when it is inside the cabinet. Behind the front panel, mounted on a shelf, are three receptacle connectors which engage the plug-in assemblies. Two aluminum shelves are permanently mounted to the frame. Twelve threaded standoffs are attached to the frame shelves for use in fastening the plug-in sub-chassis, by means of captive screws in the sub-chassis units. A hole in the rear panel of the frame assembly permits the J504 receptacle of the cabinet assembly to engage the mating connector of the Audio-Power Supply sub-chassis.

c. SUB-CHASSIS ASSEMBLIES DESCRIPTION.—These units, as indicated in figures 1-8, 1-9, and 1-10 are completely wired assemblies, designed for quick removal and replacement as plug-in units. Angle brackets, at the front and rear, form handles which facilitate handling and unplugging the units, and four mounting standoffs (one at each corner) with captive screws provide means of fastening the units to the front panel-frame assembly. The receptacle connector, located at one end, is covered by a plate to avoid contact with voltage carrying wires. All coils are shielded; all tube sockets have saddle mounts with a metal shock shield and tube shields.

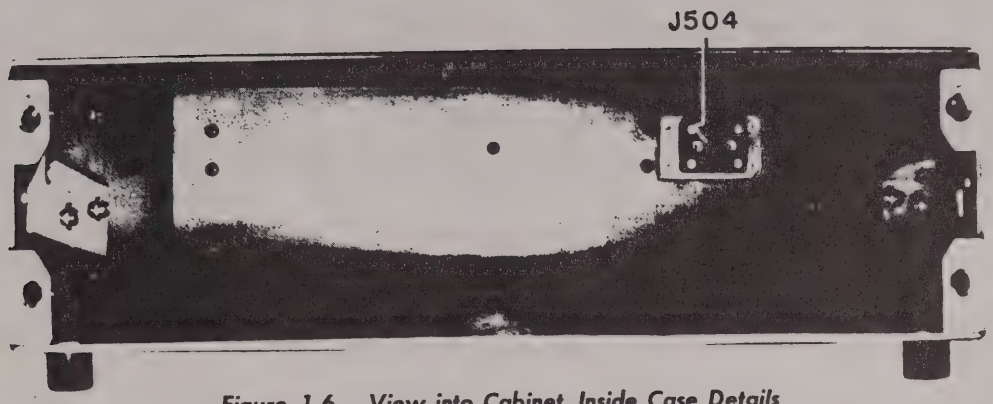


Figure 1-6. View into Cabinet, Inside Case Details

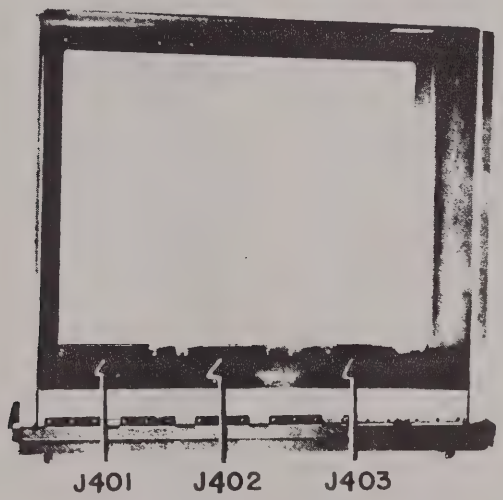


Figure 1-7. Panel, Frame Assembly

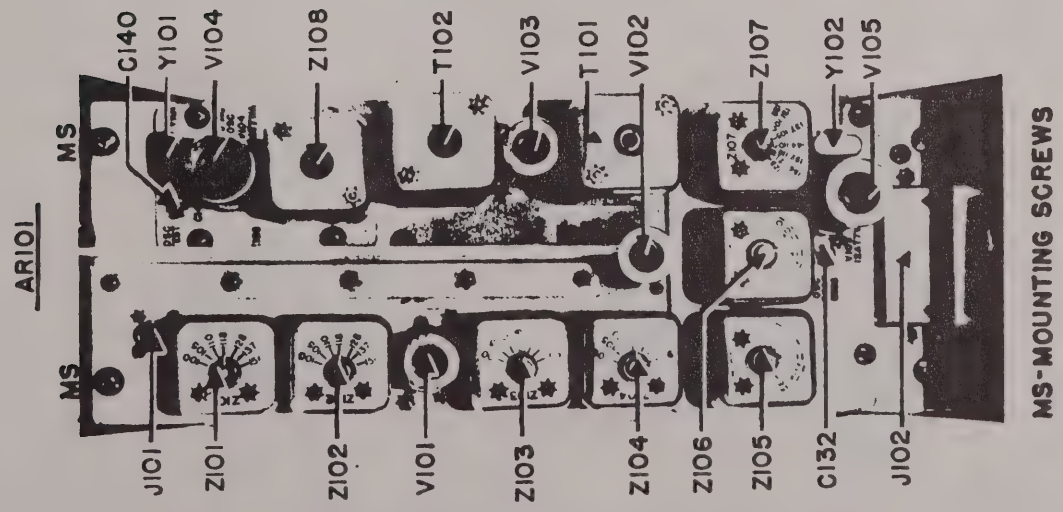


Figure 1-8. RF Sub-Chassis, Top View

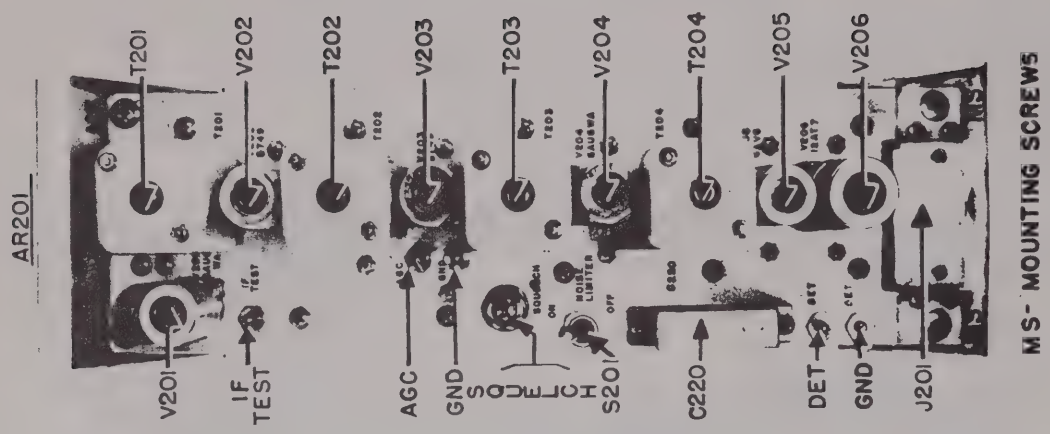


Figure 1-9. IF Sub-Chassis Assembly, Top View

d. RF SUB-CHASSIS ASSEMBLY.—This unit, shown in figure 1-8, contains an RF amplifier, a channel determining oscillator/frequency multiplier, the 1st mixer, a first IF amplifier, and the second conversion oscillator (20 Mc). All coils are contained in individual aluminum cans for isolation and reduction of interaction between different parts of the circuits. The RF can tops have frequency calibrations to aid frequency changing. The 23 Mc IF transformer slugs must be adjusted from the top and bottom of the can with a special tool furnished with the receiver. This alignment tool is mounted behind the front end plate of the Audio-Power Supply sub-chassis. A small separate sub-chassis, which is mounted slightly higher than the remaining sub-chassis level, mounts the components of the Frequency Determining Oscillator/Multiplier circuit, including the crystal Y102. A coaxial receptacle at the rear of the RF unit is provided for the antenna transmission line, which connects between the RF and Audio/Power Supply sub-chassis through a jumper and coaxial connector. A second small sub-chassis mounts the 20 Mc oscillator with its crystal Y101.

e. IF SUB-CHASSIS ASSEMBLY.—This sub-chassis, illustrated in figure 1-9, contains the 2nd mixer, three Mc IF amplifiers, the detector-AGC-squelch tube and the noise limiter-1st audio tube. All 3 Mc IF transformer slugs must be adjusted from the top and bottom of the chassis. Four feed-through test point terminals provide access to alignment points. The noise limiter switch (S201) and a slotted shaft squelch threshold control potentiometer (R216) are accessible from the top of the chassis.

f. AUDIO/POWER SUPPLY SUB-CHASSIS ASSEMBLY.—This assembly is shown in figure 1-10. Three metal cased iron-core units occupy most of this sub-chassis. Mounted in back of the power and audio trans-

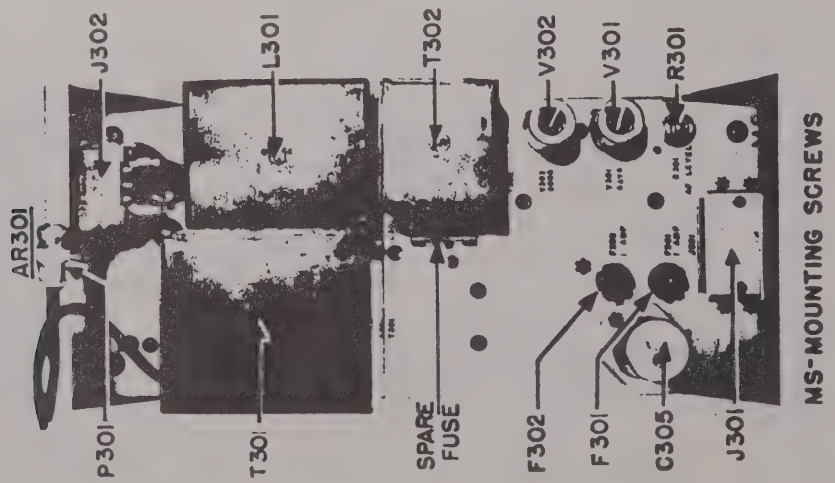


Figure 1-10. Audio-Power Supply Sub-Chassis, Top View

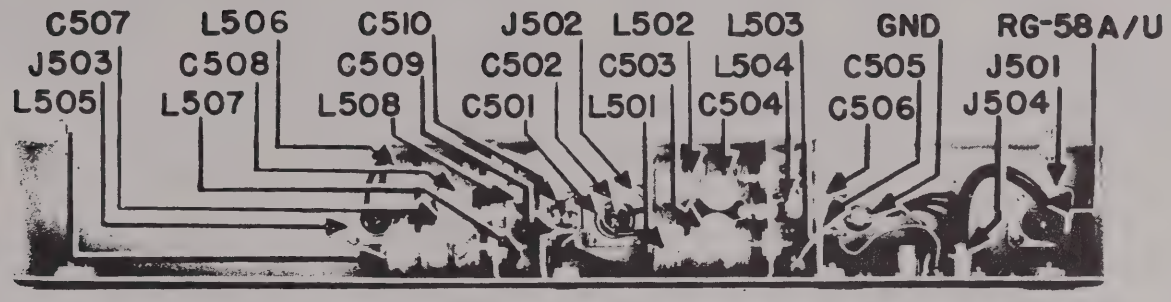


Figure 1-11. Rear Compartment Assembly, Top View

formers is the connector which mates with that of the cabinet to provide entrance of all audio, power and antenna lines. The AF LEVEL control is a slotted shaft potentiometer R301. Two post extractor type fuseholders house the two 1 ampere, slow-blow type 3AG fuses. A spare fuse is mounted in a clip, next to the T302 audio output transformer. A jumper coaxial cable, permanently mounted to the J-302 receptacle, and terminating in a coaxial connector provides coupling to the RF sub-chassis assembly.

g. REAR COMPARTMENT ASSEMBLY.—This unit, as illustrated in figure 1-11, is permanently mounted to the rear of the receiver case. To obtain access to this compartment, loosen the three Phillips type screws at the rear, and lift off the compartment cover. This unit contains RF filters used in the audio and AC lines; and the antenna transmission line. The bottom of the compartment mounts 3 receptacles to which all external connections are made.

4. ASSOCIATED EQUIPMENT.

The components and parts described below are not supplied with the receiver but are required to complete the installation of a type AN/FRR-27 radio receiving equipment.

a. ANTENNA.—The antenna to be used with this receiver must be designed to have an impedance of approximately 50 ohms, with characteristics which result in optimum matching with the transmission line in the frequency ranges most used. The applicable installation drawing will indicate the particular type of antenna to be used.

b. ANTENNA TRANSMISSION LINE.—A coaxial transmission line having a characteristic impedance of about 50 ohms, whose diameter will permit use with the AN type UG-21B/U plug (supplied with the AN/FRR-27) is required for connection between the antenna and the receiver. The applicable installation drawings indicate the type to be used for this purpose.

c. PHONES AND SPEAKER(S).—The audio circuits, available at receptacle J503 at the rear of the receiver, are designed to operate into any load impedance between 200 to 600 ohms. The output is maintained within 2 db over this impedance range. This permits numerous combinations of speakers and/or phones. A portion of the audio output is available for monitoring at the phones jack on the front panel. This jack (J404) takes a standard two conductor phone plug.

d. CRYSTAL.—The equipment is designed for use with JAN type CR-23/U crystals. This crystal is required, one for each channel to be operated, as the frequency determining crystal (Y102). The frequency formula to be used is described in SECTION 7, paragraph 4.g.; and the crystal unit is illustrated in figure 7-20.

5. REFERENCE INFORMATION.

a. REFERENCE DATA.—Pertinent data concerning Radio Receiving Set AN/FRR-27 are given below:

(1) Nomenclature—Radio Receiving Set AN/FRR-27.

(2) Contract Number—NObsr-52715.

(3) Date of Contract—29 June 1951.

(4) Contractor—Communications Company, Inc., 300 Greco Avenue, Coral Gables, Florida.

(5) Cognizant Naval Inspector—Inspector of Naval Material, Room 238, Peachtree-Seventh Building, 50 Seventh Street, N. E., Atlanta 5, Ga.

(6) Number of Packages—Complete equipment in one wood shipping case. (See figure 3-1).

(7) Total Cubical Contents (crated)—7250 cu. in.

(8) Total Cubical Contents (uncrated)—2122 cu. in.

(9) Total Weight (crated)—84 lbs.

(10) Total Weight (uncrated)—47 lbs.

b. ELECTRICAL CHARACTERISTICS.—The following is a summary of the electrical characteristics of Radio Receiving Set AN/FRR-27.

(1) Frequency Range—Rated: 100-156 Mc; maximum: 98-159 Mc.

(2) Tuning Bands—One band as indicated above (1).

(3) Number of Preset Frequencies—One, as determined by crystal unit installed.

(4) Type of Frequency Control—Crystal-controlled oscillator.

(5) Type of Receiver—Double Conversion Superheterodyne.

(6) Intermediate Frequencies—23 Mc and 3 Mc.

(7) Receiver Output—

(*a*) Audio Channel Output (J503)—Approximately 1.5 watts minimum into a 200 to 600 ohm load, with less than 7% distortion.

(*b*) Phone Jack (J404)—Approximately 15 milliwatts minimum into a 600 ohm load.

(8) Type of Reception—A2 and A3.

(9) Crystals—

(*a*) Type—JAN type CR-23/U, 20 Mc (supplied by contractor).

(*b*) Type—JAN type CR-23/U, Channel Frequency Determining (not supplied by contractor)—Oscillating frequency range of 30.2-37.75 Mc to cover receiver tuning range of 100-156 Mc with multiplication of 4 or 5, depending on frequency desired. (Complete frequency computation information given in SECTION 7, paragraph 4.g.)

(10) Receiver Frequency stability—

(*a*) Variation in line voltage + 10% of normal does not vary the resonant frequency of the receiver by more than 0.002%.

(*b*) Variation in ambient temperature between —20°C to +50°C does not vary the resonant frequency of the receiver by more than 0.01% from 25°C.

(11) Squelch (Silencer) Circuit Characteristics—

(*a*) Effective Silencing Range—1 to 100 microvolts.

(*b*) Time Constant—Does not exceed 0.2 seconds.

(*c*) Audio Output Reduction— over 40 db.

(12) Impedances—

(*a*) Antenna Input—50 ohms, unbalanced.

(*b*) Audio Channel Outputs:

1. Audio Receptacle (J503)—May be varied within the range of 200-600 ohms with less than 2 db variation of audio output.

2. Phone Jack (J404)—600 ohms.

(13) Antenna System—None supplied. An antenna having 50-ohm terminal impedance is recommended.

(14) Power Source Characteristics:

(*a*) Voltage—105/115/125 volts, 50-60 cps, 1 phase.

(*b*) Current Requirements—Nominal, 0.50 amps.

(*c*) Power—Nominal, 54 watts.

SECTION 2
THEORY OF OPERATION

1. GENERAL PRINCIPLES.

Radio Receiver R-518/FRR-27 is a double conversion superheterodyne receiver designed for single-channel, crystal-controlled operation over a frequency range of 100 to 156 Mc. The receiver provides an output of 1.5 watts with less than 7 per cent distortion which may be coupled to a local speaker(s), a remote line or speaker(s), or a combination of either. All radio-frequency coils and intermediate-frequency transformers are individually shielded to provide a maximum of isolation. The receiver selectivity curve has a low shape factor, and provides relatively flat response to the resonant frequency with sharp rejection of adjacent frequencies. A noise limiter circuit permits quieter signal reception and may be switched ON and OFF. Automatic gain control circuits regulate RF and IF amplifiers to assure signal output level stability. An adjustable squelch circuit permits setting the receiver's operating threshold at any desired point within a 1 to 100 microvolt range, as operating conditions warrant. Headtelephone monitoring of the audio signals is possible by means of a front panel headphone jack and headphone level control. The equipment is designed for 115 volts AC operation, and has high-low line voltage taps. High voltages are obtained through a transformer, selenium rectifier, and filter circuit. RF filters in the AC and audio lines provide attenuation for any interfering signals present in these circuits. The over-all block diagram, figure 2-1, indicates the relationship of the various circuits in the functioning of this receiver. The incoming signal receives one stage of RF amplification. It and the multiplied frequency from the channel-determining oscillator, are combined in the first mixer and form the 23 Mc IF. The 23 Mc signal is amplified and then is converted to 3 Mc in the second mixer. Three stages of 3 Mc amplification follow. The signal is then detected and passes through three stages of AF amplification to the speaker or other loads. The noise limiter, automatic gain control (AGC), and squelch circuits operate in conjunction with the detector.

2. DETAILED CIRCUIT DESCRIPTION.

a. RF CHASSIS ASSEMBLY.

(1) ANTENNA INPUT.—The antenna input circuit of the AN/FRR-27 is designed for use with 50-ohm coaxial transmission line, such as types RG-8, RG-9, RG-9A, or RG-10/U. The external transmission line connects to the 50 OHM ANT connector receptacle (J501), located on the rear compartment of the receiver cabinet. A type UG-21 B/U connector plug (P501), for the J501 receptacle, is supplied with the receiver for attachment to the antenna transmission line at the time of installation. A short length of RG-58 A/U coaxial cable, inside the rear compartment, extends the antenna line to receptacle J504, which is mounted to face inside the receiver case. As the receiver chassis slides into the case, the J504 receptacle engages its mating connector (J302) which is mounted at the rear of the Audio/Power Supply chassis assembly. A short length of RG-58 A/U coaxial cable, with one end permanently attached to the terminals of J302, terminates the other end in a bayonet-locking plug, AN type UG-88/U (P301). This plug mates with an AN type UG-290/U receptacle (J101) on the RF chassis assembly. This arrangement permits removal and replacement of either the Audio/Power Supply chassis or the RF chassis assembly, without unsoldering antenna connections. J101 connects to the primary of the first RF coil L101 of Z101.

(2) RF AMPLIFIER.—As indicated in figure 2-3, the RF amplifier consists of one pentode type 5654 tube (V101) and four air-wound, shielded RF coils, L101, L102, L103, and L104, each tuned by air dielectric variable capacitors C121, C122, C123, and C124. These four tuned circuits between the antenna input and the first mixer assure adequate selectivity and spurious signal rejection. The individual shielding prevents interaction between circuits. The RF coils are tapped to provide proper impedance matching for the tube grid loading which is present at high frequencies. The first RF coil L101 of Z101 has two windings, with the primary link unbalanced to ground, and inductively couples the antenna input to the secondary winding.

The signal enters the antenna coil of Z101 and is coupled to L101 which is resonated to the proper frequency by C121. The signal is then coupled to L102 of Z102 by means of L113 which tends to compensate for gain variations throughout the tuning band (100-156 Mc). C129 acts as a DC blocking capacitor. RF coil L102 is tuned to resonance by means of C122. AGC

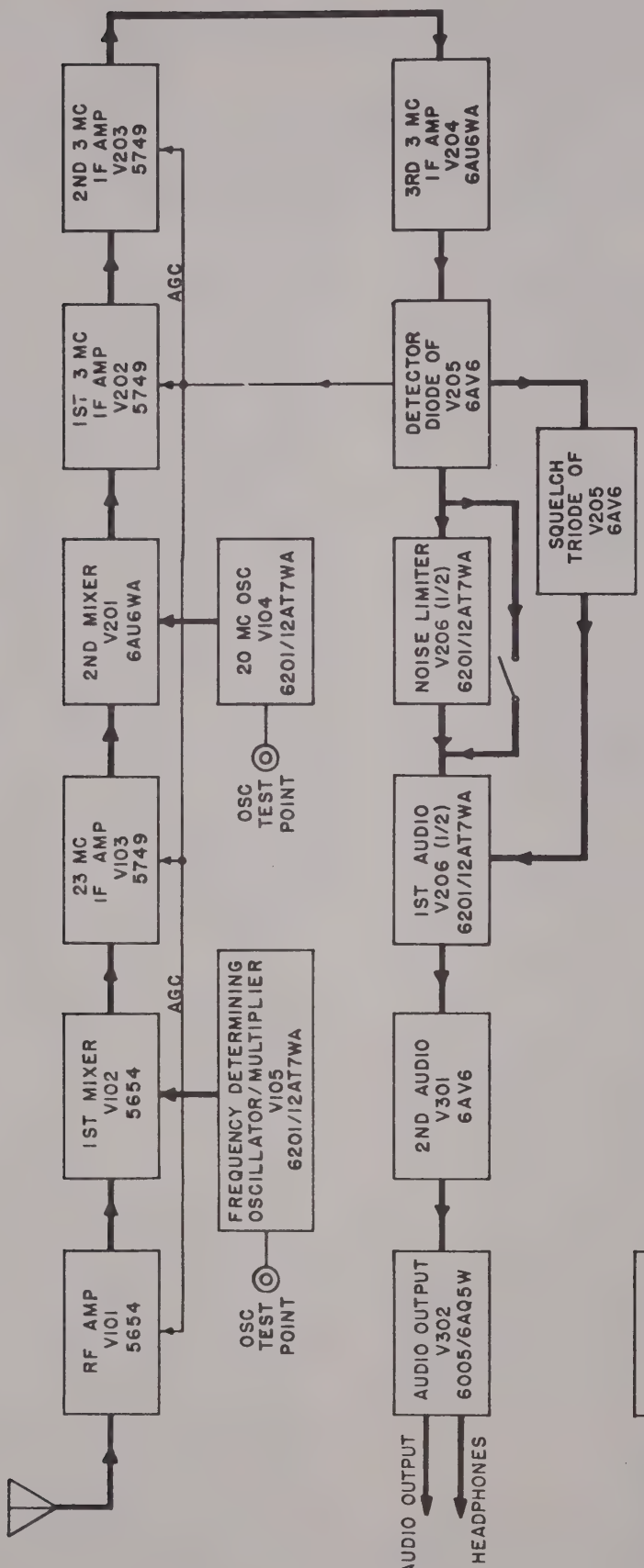

RF AMP V101 5654
IST MIXER V102 5654
23 MC IF AMP V103 5749
2ND MIXER V201 6AU6WA
IST 3 MC IF AMP V202 5749
2ND 3 MC IF AMP V203 5749
3RD 3 MC IF AMP V204 6AU6WA
DETECTOR DIODE OF V205 6AV6
SQUELCH TRIODE OF V205 6AV6
NOISE LIMITER V206 (1/2) 6201/12AT7WA
IST AUDIO V206 (1/2) 6201/12AT7WA
2ND AUDIO V301 6AV6
AUDIO OUTPUT V302 6005/6AQ5W
FREQUENCY DETERMINING OSCILLATOR/MULTIPLIER V105 6201/12AT7WA
20 MC OSC V104 6201/12AT7WA
AGC
AGC
OSC TEST POINT
OSC TEST POINT
POWER SUPPLY
VOLTAGES FOR ALL TUBES
105-125V AC SUPPLY
AUDIO OUTPUT
HEADPHONES

Figure 2-1. Block Diagram for Radio Receiver R-518/FRR-27

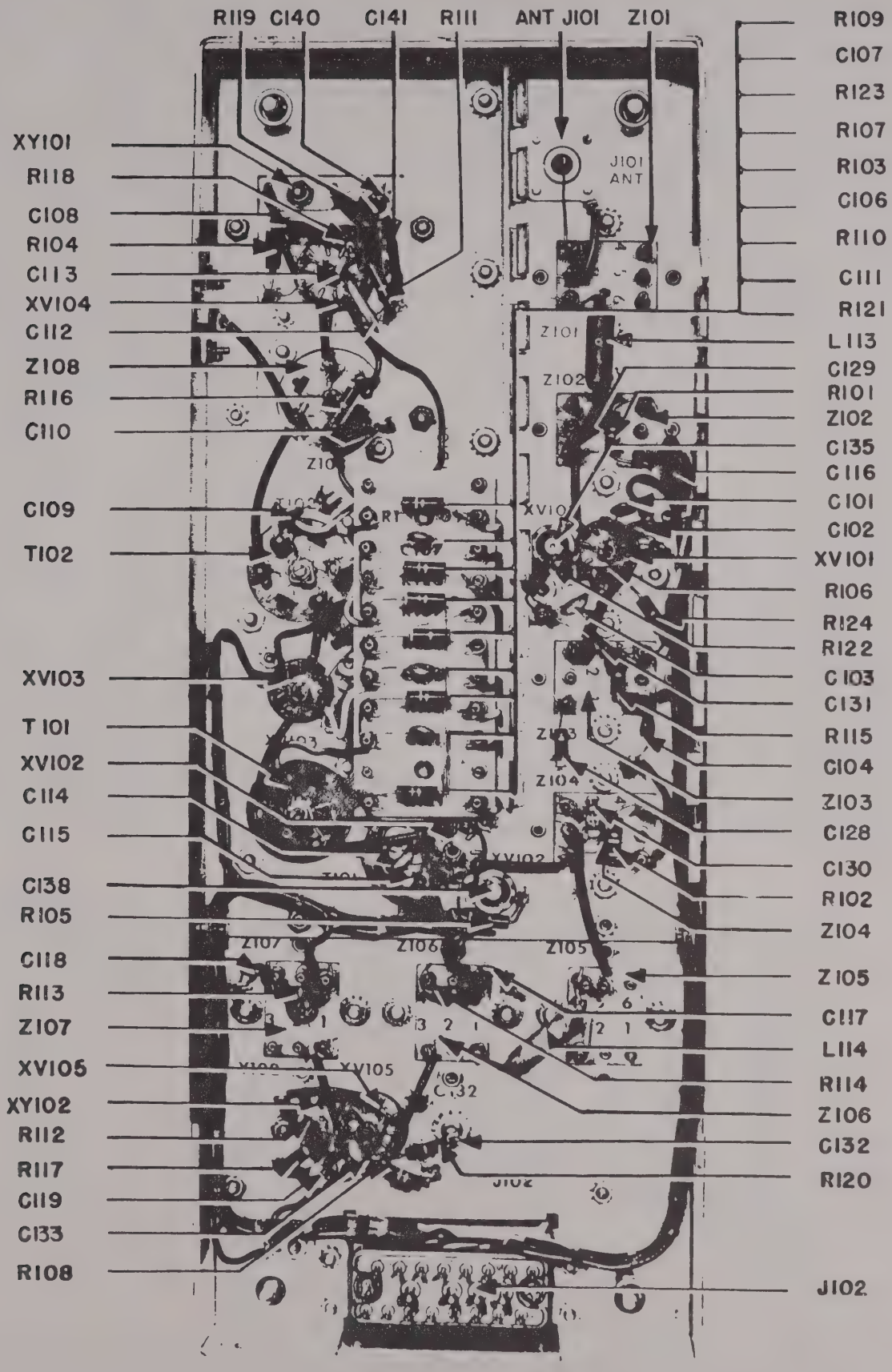


Figure 2-2. RF Chassis Assembly, Bottom View

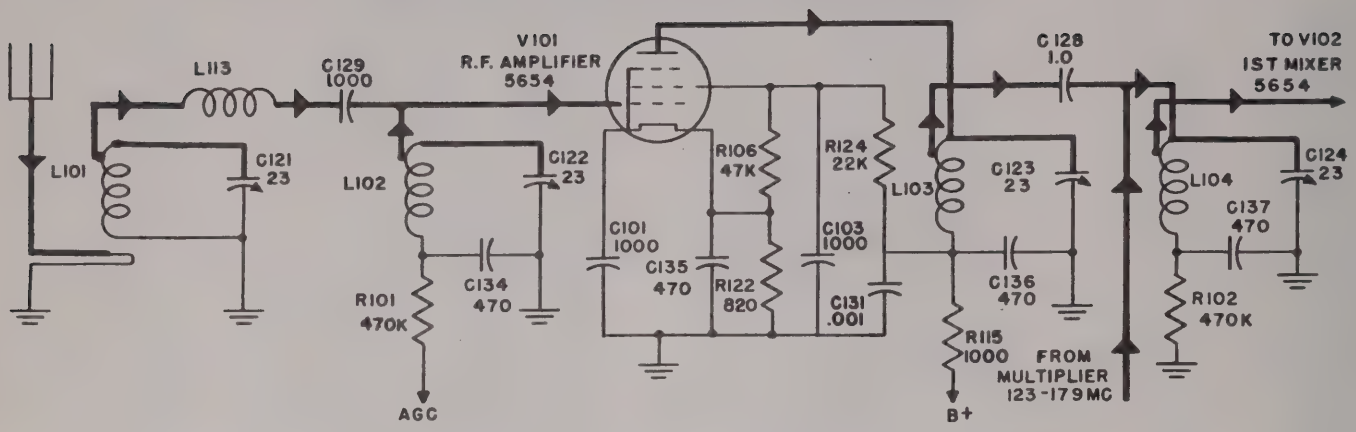


Figure 2-3. Simplified Schematic, RF Amplifier

voltage is applied to the grid of RF amplifier V101 through an isolation or filter network consisting of R101 and C134. The cathode of the RF amplifier V101 is by-passed effectively by capacitors C101 and C135 with cathode resistor R122 providing the proper grid operating bias for the tube. The screen grid of this tube is supplied with the proper operating voltage by means of a voltage divider which consists of R124 and R106 and is by-passed by C103. The plate circuit of V101 is tuned to the desired resonant frequency by means of L103 and C123 of Z103, with C136 acting as a DC blocking capacitor. L103 is coupled to the grid circuit of the 1st mixer V102 by means of coupling capacitor C128. The tuned grid circuit of the 1st mixer consists of C124 which resonates L104 of Z104 to the proper frequency. C137 is an RF by-pass for grid resistor R102, which together help prevent strong off-resonance signals from loading the mixer grid circuit. Injection voltage for the 1st mixer is coupled into the grid circuit at the high impedance end of L104. This injection voltage should always be exactly 23 Mc higher in frequency than the desired resonant frequency and is determined by proper choice of crystal frequency as outlined in section 7, paragraph 4g.

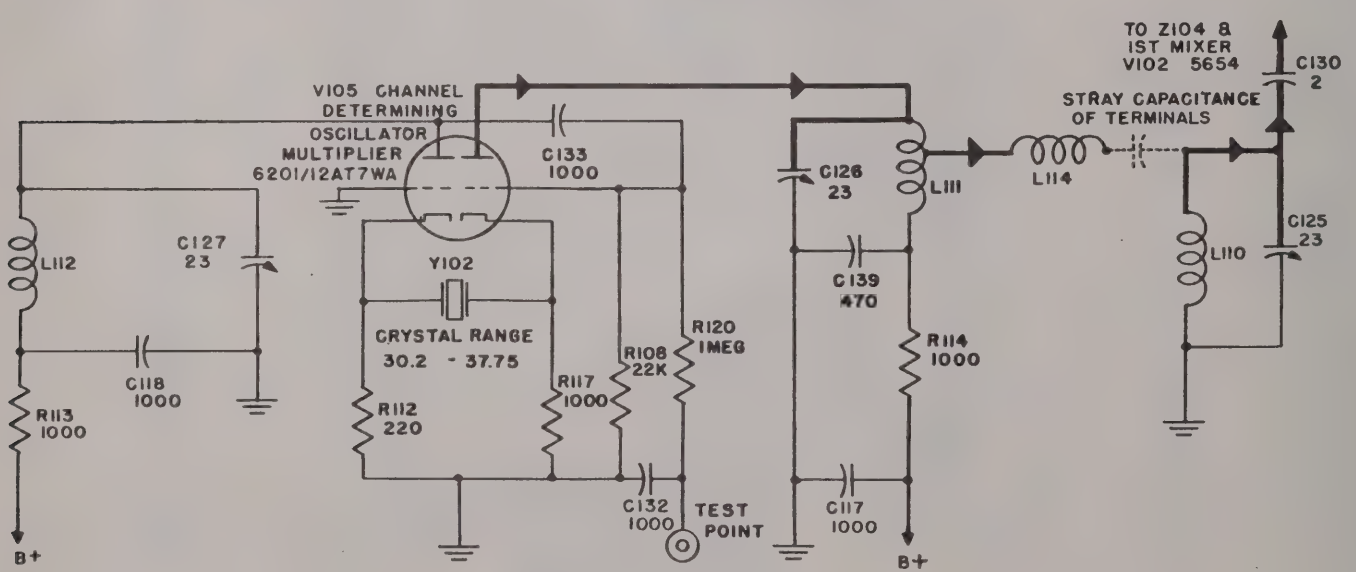


Figure 2-4. Simplified Schematic, Channel Determining Oscillator and Multiplier

(3) CHANNEL-DETERMINING OSCILLATOR-MULTIPLIER.—This portion of the RF chassis assembly determines the frequency of the incoming signal to which the receiver will respond if RF circuits are properly resonated. See figure 2-4. It consists of a type 6201/12AT7WA dual triode tube (V105) whose sections function as a crystal oscillator and frequency multiplier. The oscillator-multiplier section generates a signal whose frequency is 23 Mc above that of the incoming signal. Mixing this signal with the incoming signal provides the desired 23 Mc first IF signal. The channel-determining crystal (Y102) is a nontemperature controlled type CR-23/U, selected to operate in the frequency range between 30.2 to 37.75 Mc. This crystal is not supplied with the receiver as its frequency will depend on the signal frequency to be received. The oscillator portion of this circuit operates in the following manner. With the proper crystal inserted in crystal socket XY102, only the crystal frequency is coupled to the cathode resistor R112 of the grounded-grid section of the dual triode V105. The crystal frequency is amplified in this section of the dual triode; and when the plate circuit L112 is brought to resonance at the crystal frequency by means of the variable capacitor C127, sufficient drive will be coupled through coupling capacitor C133 to the grid of the second section of the dual triode. This grid is driven to a point where grid current will flow through grid resistor R108, thus producing a DC grid bias voltage which flows through a decoupling filter R120 and C132 and is present at the oscillator test point. This voltage can then be read by connecting a vacuum tube voltage meter to this test point. By tuning C127 for maximum at this test point, the crystal oscillator is properly adjusted. This second section of the dual triode acts as a cathode follower with the cathode load resistor R117 coupling the crystal frequency through the crystal to the first section of the dual triode V105, thus providing the proper feedback to produce a proper state of oscillation. R113 and C118 form an isolation network to connect the B voltage to the plate of the first section of the dual triode. The second section of the dual triode, as stated, acts as a cathode follower at the crystal frequency because the plate circuit consisting of L111 of Z106 and C126 is not resonated to the crystal frequency and, therefore, is effectively grounded. Since the grid circuit is driven and is biased properly, the plate circuit is rich in harmonics. The plate circuit should be tuned to emphasize the 4th or 5th harmonic. The RF multiplier tuned circuit L111 and C126 has a tuning range of 123-179 Mc. For an RF channel between 100-128 Mc, the 4th harmonic is used; and for an RF channel between 128-156 Mc, the 5th harmonic should be used. B+ voltage is fed to the plate of the second section of the dual triode through an isolation network consisting of C117, R114, and C139. This isolation network keeps the multiplied frequency out of the B supply voltage. The output of L111 of Z106 is coupled to an injection tuned circuit consisting of L110 of Z105 and is resonated to the desired harmonic by means by C125. The coupling is made more uniform throughout the tuning range of the multiplier coils by the use of coupling coil L114 and the stray capacitance between the two coil base terminal pins. L110 and C125 of Z105 provide rejection of undesired harmonic frequencies. The desired harmonic is then coupled to the

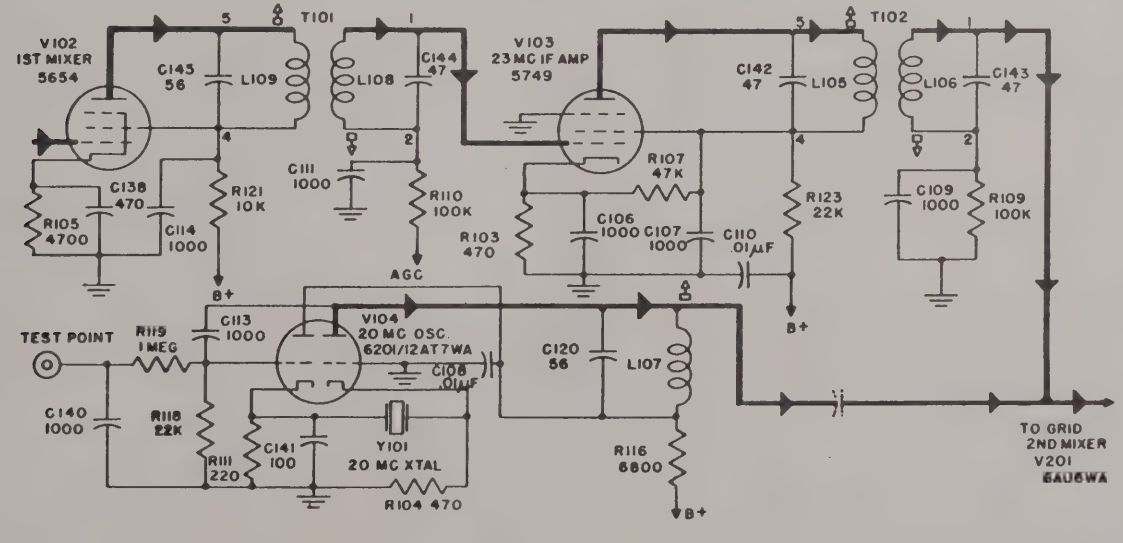


Figure 2-5. Simplified Schematic, First Mixer, 23 Mc IF Amplifier 20 Mc Oscillator

grid circuit of the 1st mixer through coupling capacitor C130. All of the RF coils are individually shielded to prevent circuit interaction.

(4) FIRST MIXER.—As indicated by figure 2-5, this mixer uses a 5654 tube (V102) to mix the output of the RF amplifier with the output of the oscillator/multiplier, to provide the first IF of 23 Mc. The output of the RF amplifier and the oscillator/multiplier are coupled into the grid of the first mixer V102. The proper grid bias for proper mixing is obtained by the use of cathode resistor R105 which is by-passed by capacitor C138. The plate and screen voltages are obtained through an isolation network which consists of R121 and by-pass capacitor C114. The plate circuit is tuned to the desired first IF of 23 Mc by means of C145 and slug tuned coil L109.

(5) 23 MC AMPLIFIER.—This amplifier, shown in figure 2-5, utilizing one type 5749 tube (V103) and two permeability tuned 23 Mc IF transformers, T101 and T102, has been designed for approximate unity gain and provides only sufficient amplification to compensate for normal circuit losses. The transformers T101 and T102, each with two adjustable iron cores, have their primaries tuned from the top and their secondaries from the bottom. The 23 Mc signal is coupled from the plate circuit of the 1st mixer V102 by means of mutual inductive coupling from L109 to L108 of T101. L108 and C144 are resonated to 23 Mc and couple the signal into the grid of the 23 Mc amplifier V103. AGC voltage is applied to the grid of V103 through a decoupling or isolation network consisting of R110 and by-pass capacitor C111. Proper bias for class A operation of the 23 Mc IF amplifier is obtained by cathode resistor R103 and is by-passed by capacitor C106. Plate and screen voltages are obtained from a voltage divider which consists of resistors R123 and R107. These resistors, together with by-pass capacitors C110 and C107, provide the proper isolation of plate and screen from the B voltage supply. The plate circuit of V103 is tuned to 23 Mc by means of C142 and L105 of T102 and is coupled to L106. C143 together with L106 resonate to 23 Mc and are coupled directly into the grid of the second mixer V201, which is located on the IF chassis assembly. R109 together with by-pass capacitor C109 help prevent circuit overload and blocking on very strong off resonance signals.

(6) 20 MC OSCILLATOR.—This oscillator, shown in figure 2-5, operating at 20 Mc, combines in the second mixer with the 23 Mc IF signal from the first IF amplifier to produce the 3 Mc second IF frequency. The oscillator circuit is similar to that of the frequency-determining oscillator, excepting that only the crystal frequency is used, and all harmonics are by-passed. In this circuit, also, provision is made to permit checking of the grid voltage at a test point on top of the chassis for tuning purposes. The oscillator tube, V104, is a type 6201/12AT7WA, and the circuit is resonated to 20 Mc by means of the permeability tuned, shielded RF coil L107, and capacitor C120. Part of the oscillator output is coupled through capacitor C113 to the first section of the dual triode V104, causing grid current to flow through grid resistor R118 causing a DC voltage to be developed across it. This voltage is filtered through R119 and appears across C140 at the 20 Mc test point. The first section of the dual triode V104 acts as a cathode follower because the plate is by-passed by C108 and the load resistor R111 in the cathode circuit. The 20 Mc energy is permitted to pass through the 20 Mc crystal

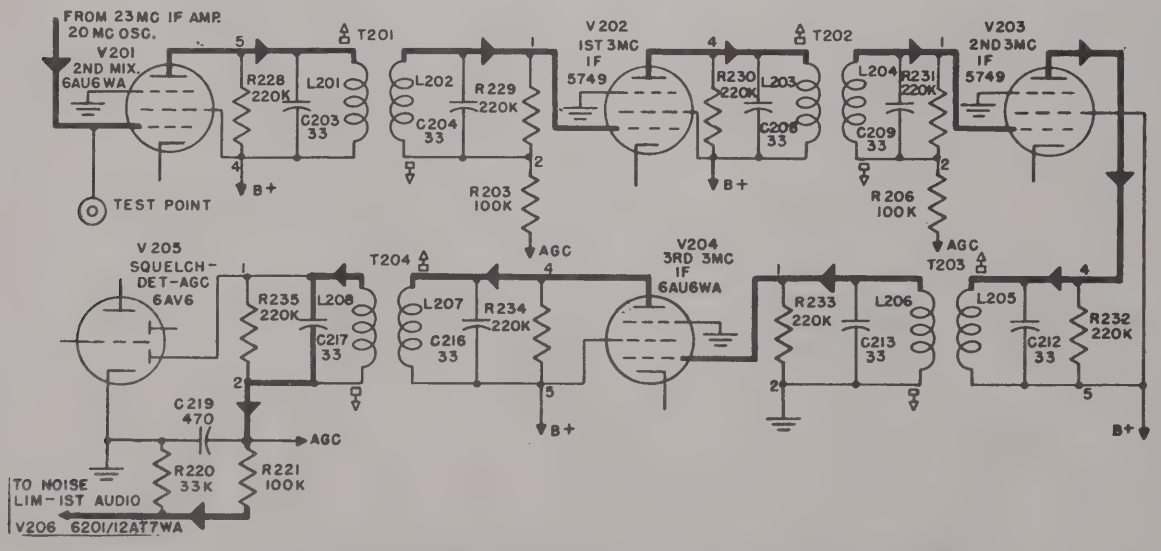


Figure 2-6. Simplified Schematic, 2nd Mixer and 2nd IF Amplifier

Y101 and appears across the cathode resistor R104 of the second section of the dual triode which acts as a grounded-grid amplifier. The plate of the second section, as stated before, is tuned to 20 Mc by L107 and C120. Part of the 20 Mc is coupled back to the grid of the first section but most of it is coupled to the grid of the second mixer V201 by means of transformer pin capacitor. Plate voltage is applied to the plates of the 20 Mc oscillator through isolation resistor R116 and is effectively by-passed by C108. Cathode capacitor C141 is used to reduce undesired harmonics of the 20 Mc oscillator which are present.

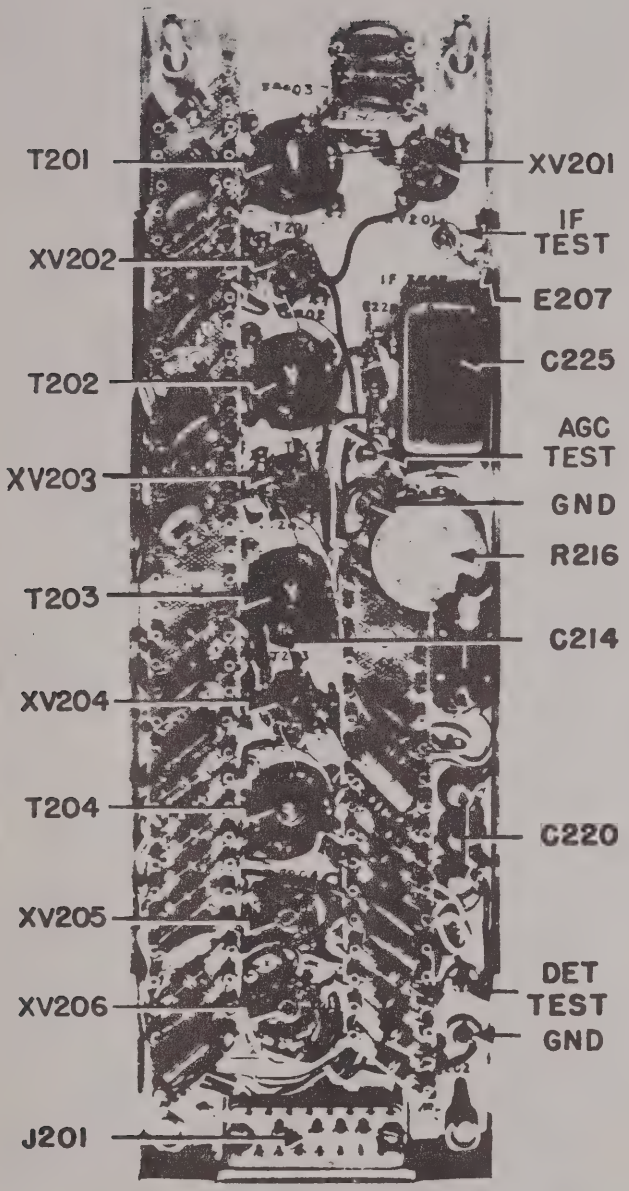
b. IF CHASSIS ASSEMBLY.

(1) SECOND MIXER-3MC IF AMPLIFIER.—As shown in figure 2-6, a type 6AU6WA tube, V201, is used as the second mixer. The 23 Mc first IF and the 20 Mc oscillator signals are present in the grid circuit and combine in this tube to produce the 3 Mc second IF frequency, which is present in the plate circuit. A test point is provided on the top of the chassis, see figure 2-7, to permit injection of a 3 Mc signal on the control grid of this tube, for 3 Mc IF alignment. The plate circuit is tuned to resonance at 3 Mc by padder capacitor C203 and L201 of T201. L201 is coupled by mutual inductive coupling to L202, which with C204 also tunes to 3 Mc and applies the signal to the grid of the 1st 3 Mc amplifier 5749 (V202). AGC voltage is applied to this grid through isolation resistor R203. V202 amplifies the 3 Mc signal, present in the plate circuit consisting of C208, and L203 of T202 and it is coupled to the second 3 Mc amplifier 5749 (V203) grid circuit L204 and C209. AGC voltage is applied to V203 through isolation resistor R206. Again the signal is amplified by V203, and the plate circuit is resonated to 3 Mc by L205 and C212, and is coupled to L206 and C213 of T203 in the grid circuit of the last 3 Mc IF amplifier 6AU6WA (V204). AGC voltage is not applied to the last IF amplifier, since it must operate at high level linear conditions. The plate circuit of V204 is resonated to 3 Mc by C216 and L207 of T204 which is coupled to L208 and C217 of the detector 6AV6 (V205). All of the 3 Mc IF transformers are tuned to resonance by powdered iron slugs. The primaries are tuned from the top of the shielded can and the secondaries from the bottom by an insulated screwdriver. Each of the windings of the transformers are loaded with a 220,000 ohm resistors, namely, R228, R229, R230, R231, R232, R233, R234, and R235, to broaden the bandpass of the IF amplifier to the desired degree. Signal from the last tuned circuit L208 and C217 is applied on one of the diode plates of V205, causing the diode to rectify the signal and produce AGC voltage across IF by-pass capacitor C219 and audio voltage across the audio voltage divider consisting of R221 and R220.

(2) DETECTOR-NOISE LIMITER.—As indicated in the simplified schematic of figure 2-8, one diode section of a type 6AV6 tube (V205) is used as a detector, and one half of a double-triode type 6201/12AT7WA tube (V206) functions as a noise limiter. The detector circuit is conventional. IF transformer T204 couples the signal to the detector. Resistors R220 and R221 constitute the diode load, which is by-passed for RF by C219. The audio frequency output, obtained at the junction of R220 and R221 is coupled through capacitor C227 to the grid of AF amplifier V206, when the noise limiter switch (S201) is in the OFF position.

When the noise limiter switch is in the ON position, a series self-adjusting noise limiter or clipper is placed in the circuit between the detector and the first audio. This limiter circuit, which uses one half of V206, functions as follows: A negative voltage, proportional to the carrier level, is developed across the detector load which is composed of R221 and R220. This voltage is filtered through a network composed of R210 and C220B. This network has a time constant sufficiently long to prevent any sharp noise pulses from affecting the voltage applied through the cathode load resistor R224 to the cathode of the noise limiter V206A which consists of one-half of a 6201/12AT7WA dual triode. A portion of the rectified signal is divided by means of R221 and R220 and is applied to the plate and grid of the noise limiter V206A which are tied together and, therefore, cause this tube section to act as a diode. The average voltage applied to the plate (and grid) is less negative than that applied to the cathode. This, in effect, puts positive voltage on the plate in respect to the cathode. The diode will then conduct and the audio signal will be passed on through the diode and coupling capacitor C227 to the grid of the first audio amplifier. When noise peaks or modulation peaks exceed approximately 60 per cent modulation level, the plate will become negative in respect to its cathode, thus causing the diode to be nonconductive to that portion of the signal exceeding 60 per cent modulation. Switching the noise limiter circuit ON or OFF will change the audio level by approximately 1 db.

(3) AUTOMATIC GAIN CONTROL (AGC).—A delayed type of automatic gain circuit is utilized, as indicated in the simplified schematic of figure 2-9; "delayed" meaning a voltage delay, not a time delay. This circuit functions in such a way that AGC action is delayed until the incoming carrier strength reaches a predetermined level and then a control voltage is applied to the stages to be regulated. In this circuit, the rectified signal voltage on the detector is applied to the AGC bus through resistor R217 which, with C220A, form a filter which removes any RF and gives the proper time constant or time delay to the AGC operation. Volt-



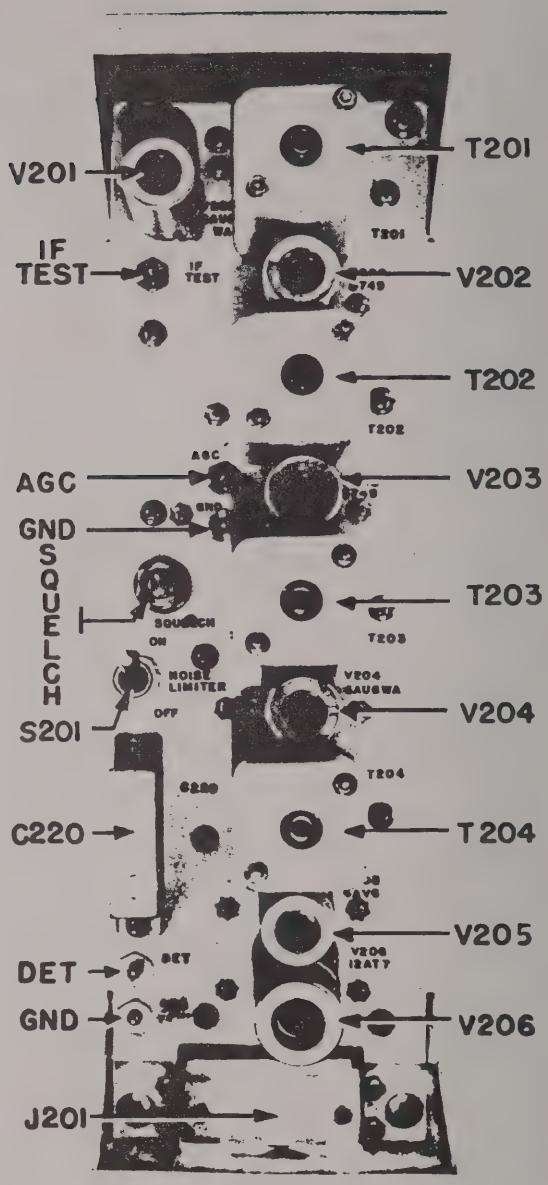


Figure 2-7. IF Chassis, Bottom and Top Views

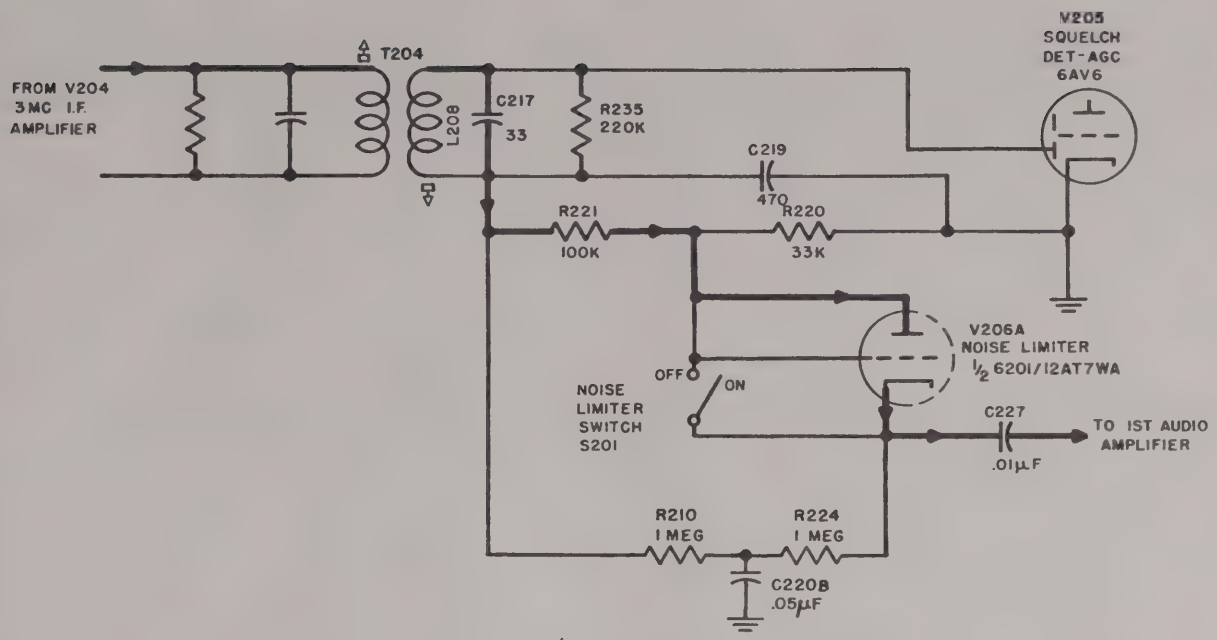


Figure 2-8. Simplified Schematic, Detector and Noise Limiter

age delay is accomplished by supplying a positive voltage from the voltage divider R211 and R204 through series resistor R213 to the AGC bus. This positive voltage bucks out a portion of any negative voltage supplied by the detector being fed through R217, thus preventing the AGC bus from going negative until the rectified detector voltage increases beyond a predetermined level. In order to prevent the AGC bus from going positive, a stopper diode is used. This is the second diode of V205, which has a grounded cathode. If the AGC bus tends to be positive due to the positive delay voltage through R213, this diode will conduct and prevent it from rising over 0.1 to 0.2 volt positive, but as the bus goes negative due to signal, this diode stops conducting. AGC voltage is applied to the RF stage V101, the 23 Mc IF stage V103, the first 3 Mc IF stage V202, and the second 3 Mc IF stage V203. The AGC system will hold the audio output constant within 3 db over the range of 10 times the AGC threshold (beginning of operation) and 10,000 times the AGC threshold.

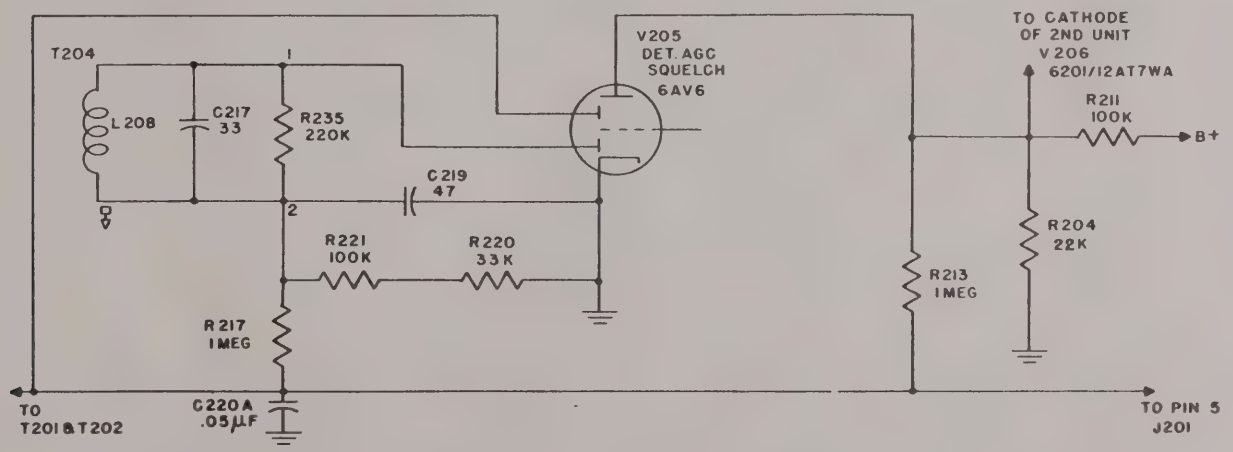


Figure 2-9. Simplified Schematic, Automatic Gain Control

(4) SQUELCH OR SILENCER.—A squelch system consists, essentially, of a method of assessing the reception conditions and disabling the receiver when the desired signal is not present. In the simplified squelch circuit of figure 2-10, silencing the receiver is accomplished by biasing the grid of the first audio amplifier, V206, beyond cutoff. The triode section of 6AV6 (V205) is used as the "squelch" tube. The plate of this tube is connected to a B+ source, consisting of divider R211 and R204, through resistor R222. With one end of R222 connected to the cathode of the first audio tube V206 and the other end to the grid resistor R214 of V206, any current flow through R222 causes a voltage drop which makes the grid more negative with respect to the cathode and biases V206 to cutoff. R237 is a resistor that applies a slight amount of audio AGC to the grid of the first audio amplifier V206. C226 is used as a by-pass filter capacitor. When the squelch tube does not conduct, there is no voltage drop across R222, and the audio amplifier functions normally.

The squelch circuit operates in the following manner: When a signal is being received, the rectified signal, present at the detector, applies a negative voltage to the squelch grid of V205 through R202 and is filtered by means of C220C. This DC voltage is negative and is bucked out by a positive voltage supplied from the first audio plate V206. This positive voltage is divided down by means of R227 and squelch threshold control R216. C221 acts as a by-pass filter. R216 is used to adjust this positive voltage to a desired value. This positive voltage then passes through the squelch test switch S402 which, when pressed, disconnects this voltage. This voltage then is applied through R225 to the grid of the squelch tube V205 to buck out a portion of the negative voltage being supplied by the detector.

When the signal at the detector supplies a negative voltage of a value large enough to overcome the positive voltage on the grid, then the grid will go negative and cause the squelch tube V205 to be cut off. No current will then be drawn through resistor R222. The bias that was previously developed across R222 is now absent and the first audio V206 becomes operative and amplifies the audio applied to its grid. When this condition exists, the first audio is now drawing plate current, causing a voltage drop across plate resistor R218. This reduces the positive delay voltage supplied through the squelch threshold control to the grid of squelch tube V205. The signal will now have to drop to a much lower value before the squelch will again close. This means that, for a higher setting of the squelch threshold control, a signal just strong enough to open the squelch will open it solid, and that the signal can fade considerably without the squelch again closing. At a low setting of the squelch control, this action is less because the squelch control applies less positive voltage from the first audio plate circuit. This action is less desirable at a low setting of the squelch threshold control because high noise levels could hold the squelch open after the signal has ceased to be transmitted. The normally closed squelch test switch S402, when pressed, disconnects the positive delay voltage and the squelch opens.

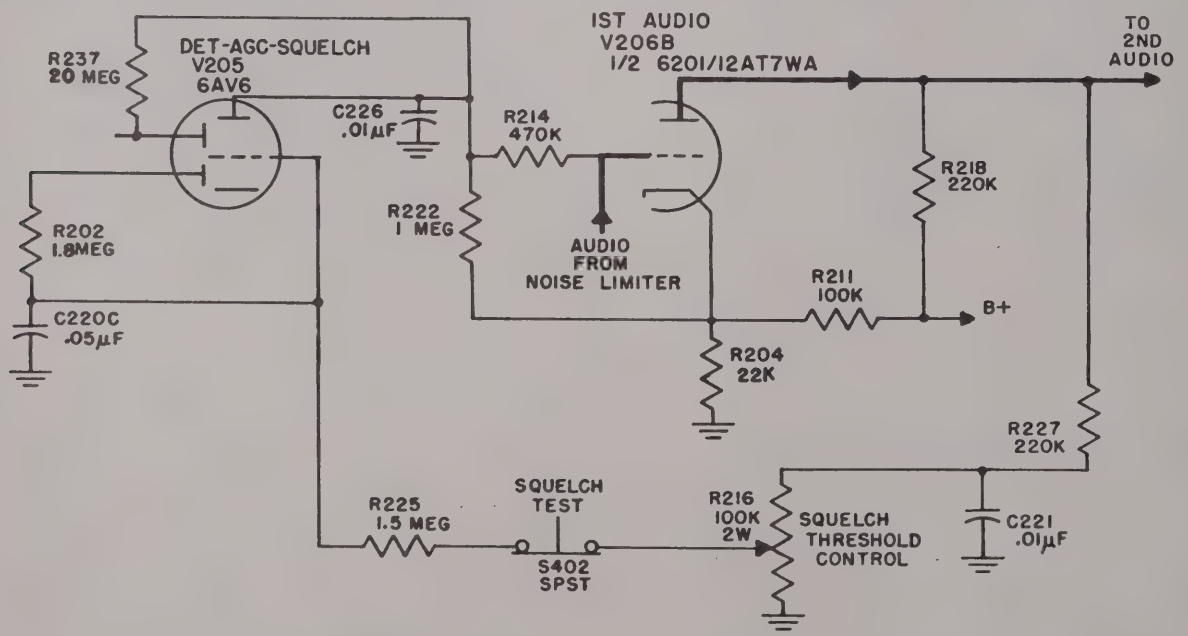


Figure 2-10. Simplified Schematic, Squelch Circuit

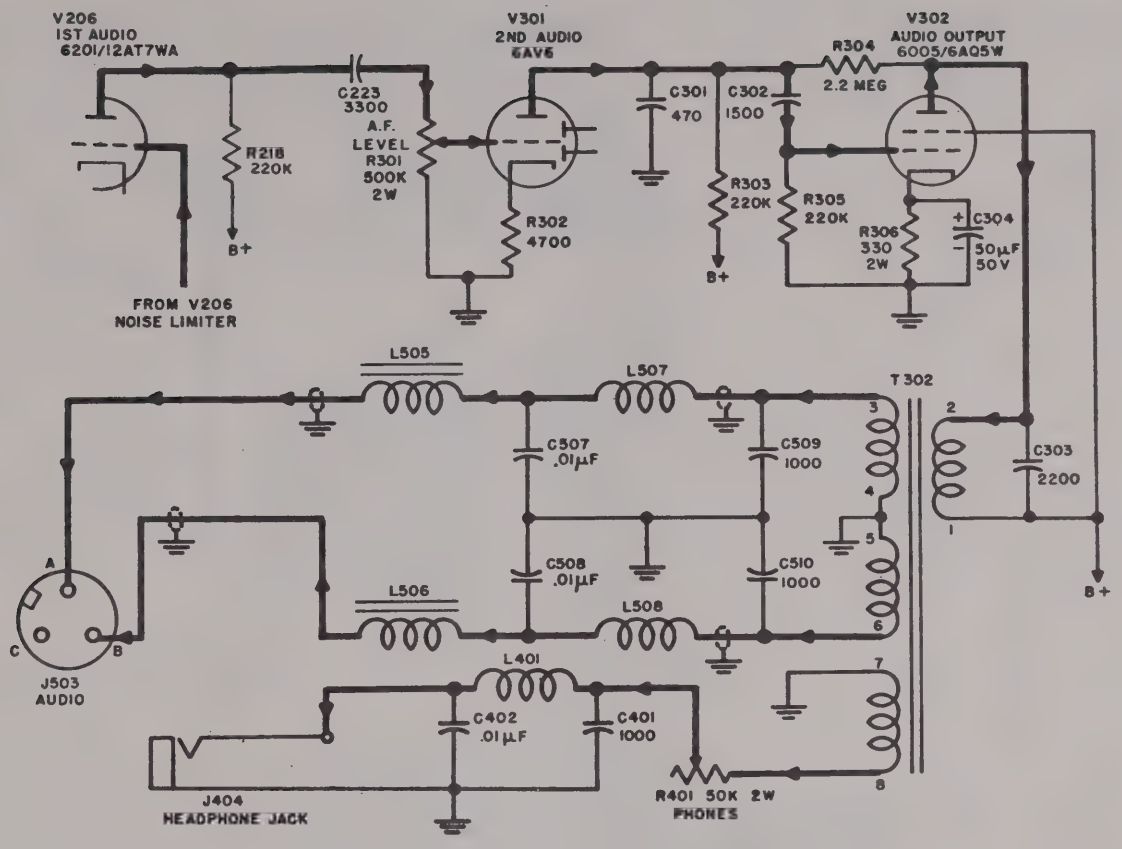
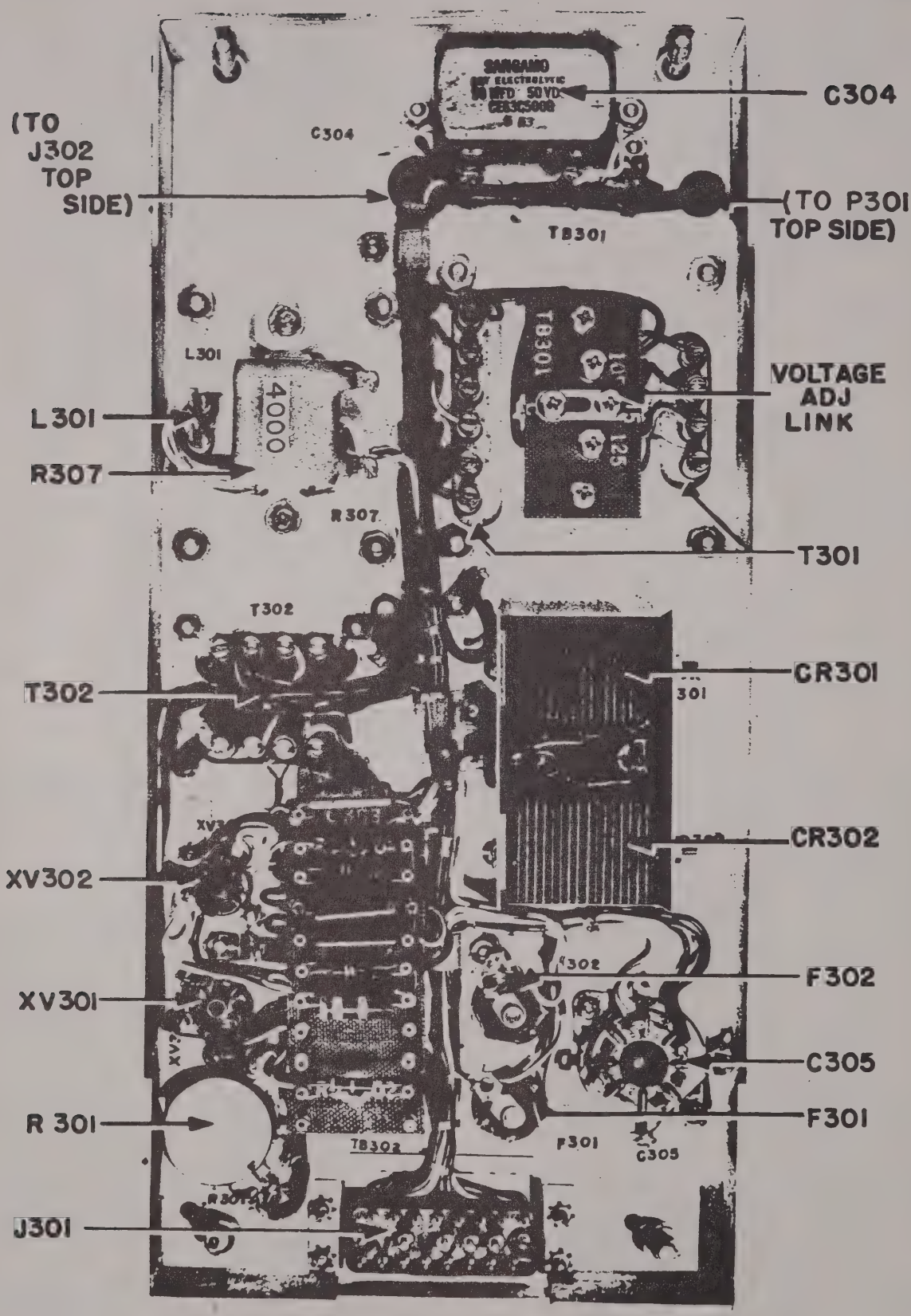


Figure 2-11. Simplified Schematic, Audio Amplifier and Output

c. AUDIO-POWER SUPPLY CHASSIS ASSEMBLY.

(1) AUDIO AMPLIFIER AND OUTPUT.—The audio amplifier, as indicated in the simplified schematic of figure 2-11, is basically conventional. Inverse feedback is used to permit audio output load changes with a minimum of change in output level; the audio output is maintained within 2 db over a load variation of 200 to 600 ohms. Over-all distortion is less than 7 per cent for 1.5 watts output with a load of 200 to 600 ohms. With a 600 ohm load, the frequency response is flat within 2 db over the range of 300 to 3500 cycles. Above 3500 cycles, the response takes a sharp drop and at 30,000 cycles is down more than 45 db. The audio signal from the noise limiter output is applied to the grid of the triode connected section of the 6201/12AT7WA (V206) which acts as an audio amplifier. The amplified signal on plate resistor R218 is coupled through capacitor C223 and through the A.F. LEVEL control R301 to the grid of the second audio amplifier tube 6AV6 (V301). Cathode resistor R302 provides the proper operating bias for V301. The amplified signal is developed across plate load resistor R303 which is bypassed by audio shaping capacitor C301. The signal is coupled to the grid of the audio output tube 6005/6AQ5W (V302) by means of coupling capacitor C302 which helps limit the low-frequency response of the amplifier. This is due to its small value compared to the value of grid resistor R305. Proper bias for the audio output amplifier grid is obtained by cathode bias resistor R306 which is by-passed by electrolytic capacitor C304. Transformer T302 is chosen to reflect the proper load of 5000 ohms to the plate of the audio output tube V302. Resistor R304 provides the proper amount of inverse feedback to the plate circuit of the 2nd audio amplifier to permit the audio load impedance on the secondary of the output transformer (audio output receptacle J503) to be varied over the range of 200 to 600 ohms without causing more than 2 db change in audio output. Capacitor C303 across the primary of the audio output transformer T302 helps shape the audio response.

The secondary of the audio output transformer T302 has two windings. One winding provides the signals necessary for monitoring from the front panel headphone jack (J404). This winding, grounded at one end, is designed to supply a maximum of approximately 15 milliwatts of audio to a pair of 500 to 600 ohm headphones. The headphone level is varied by means of headphone level control R401 which is capable of con-



Frgure 2-12. Audio/Power Chassis Assembly, Bottom View

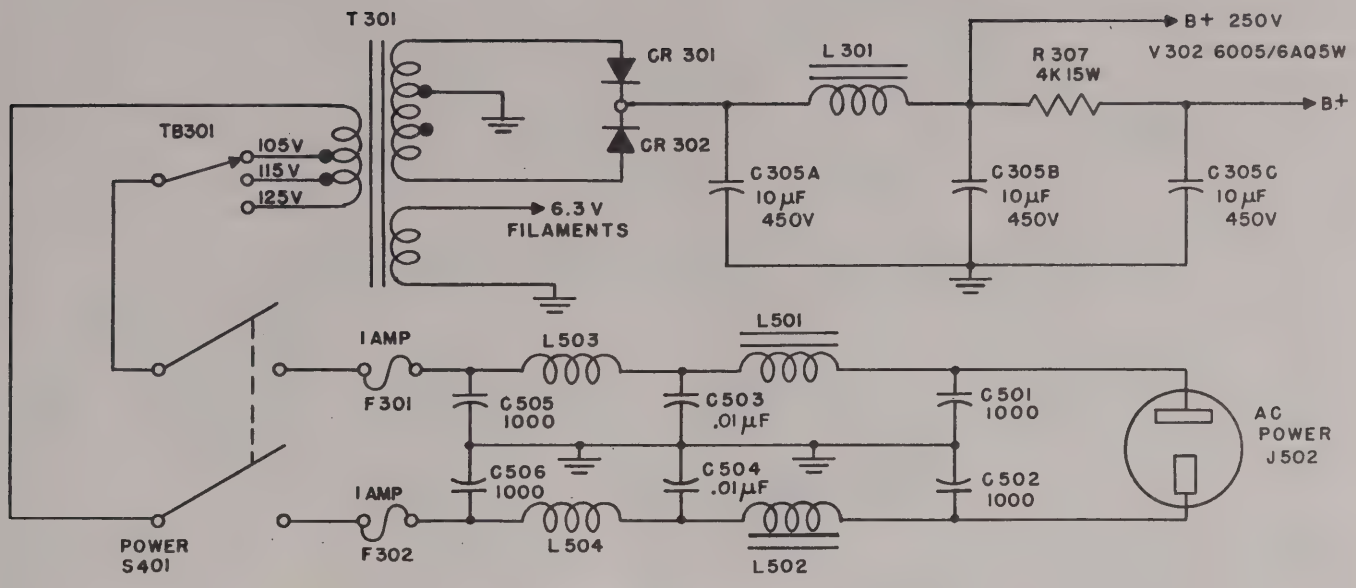


Figure 2-13. Simplified Schematic, Power Supply

trolling the level over at least 30 db. A headphone filter, which is composed of C402, L401, and C401, is employed and is used to filter out any RF which might be picked up by the headphone, or any oscillator signals which might be radiated from the receiver. The other secondary winding of T302 has an output impedance of 300 ohms, with a center tap which is grounded. This winding is electrostatically balanced and is well suited for remoting. An RF filter is employed between this winding and the audio receptacle (J503), which is located in the rear filter compartment. This filter is composed of a two-section filter. One section, composed of L505, L506, C507, and C508, is effective over a range of approximately 2 to 40 Mc. Another section, composed of L507, L508, C509, and C510, is effective over the range of approximately 40 to 200 Mc. The audio load on this winding can be varied within the range of 200 to 600 ohms with a variation of less than 2 db. This winding can be used for a local speaker or speakers, and for a remote line individually or simultaneously.

(2) POWER SUPPLY.—As outlined in the simplified schematic, figure 2-13, the power supply consists of a full-wave rectifying system, using selenium rectifiers and provides for multi-tap selection of the AC voltage source. A 2-pin receptacle (J502), located on the rear compartment, provides connection to the AC power source. Both sides of the AC line pass through an RF filter system, also located in this rear compartment. This filter system is composed of two sections, the first section consists of L501, L502, C503, and C504, which will attenuate signals in the range 2 to 40 Mc. The second filter section composed of C501, C502, L503, L504, C505, and C506, which will attentuate signals in the range of 40 to 200 Mc. Both sides of the AC line then passes through two fuses F301 and F302, which are 1 amp 3AG slow-blow fuses. Slow-blow fuses are used to prevent current surges from burning the fuses if an intermittent connection is made to the power source. The AC line then passes through DPST switch S401 which is mounted on the front panel. The AC line then is connected to the primary of power transformer T301 through a single-pole three-position switch which is mounted on TB301, located on the underside of the power supply chassis. This switch is used to select one of the three taps on the primary of T301, which are labeled 105 V, 115 V, or 125 V. The voltage of the AC power source should be measured and the appropriate tap selected. Power transformer T301 has two secondaries, one of which supplies 6.3 volts AC to the filaments of all the tubes in the receiver. The other winding is the high voltage winding which supplies approximately 225V RMS AC to the selenium rectifiers CR301 and CR302, which are connected as a full-wave rectifier. The power transformer T301 has a 75 volt AC bias tap which is not used in this equipment. The high voltage rectifiers CR301 and CR302 are each a manufacturer's voltage doubler type. However, in the AN/FRR-27, the center-tap is not used, and each unit performs as a half-wave rectifier. The output of these rectifiers feed a capacitor input filter, consisting of L301, R307, and C305 (A-B-C). C305 is a three-section plug-in electrolytic capacitor. The fully filtered B plus output voltage, approximately 115 volts, supplies most of the requirements of the receiver. The B plus is also tapped off between L301 and R307 to furnish approximately 240 to 250 volts to the audio output tube V302.

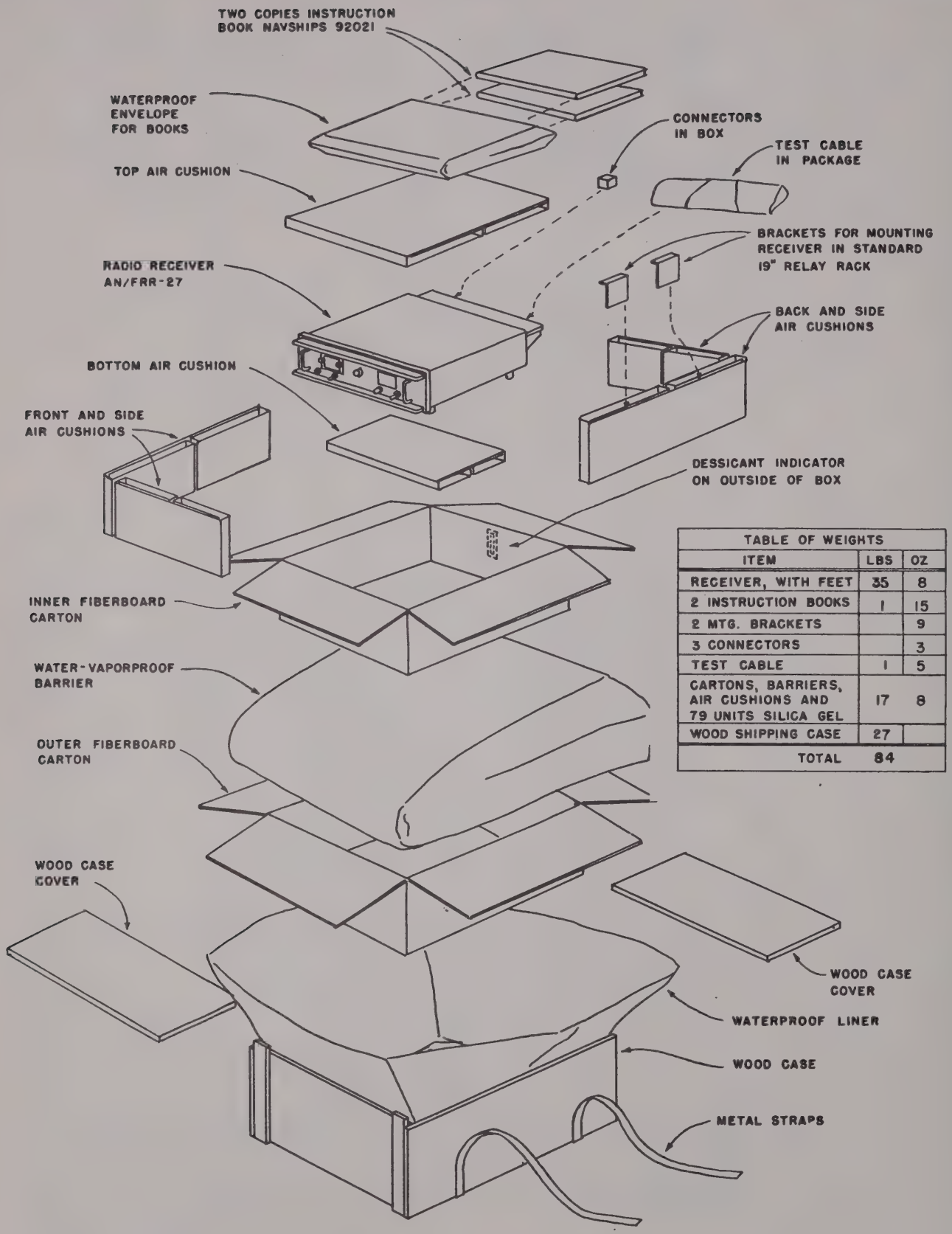


TABLE OF WEIGHTS		
ITEM	LBS	OZ
RECEIVER, WITH FEET	35	8
2 INSTRUCTION BOOKS	1	15
2 MTG. BRACKETS		9
3 CONNECTORS		3
TEST CABLE	1	5
CARTONS, BARRIERS, AIR CUSHIONS AND 79 UNITS SILICA GEL	17	8
WOOD SHIPPING CASE	27	
TOTAL	84	

Figure 3-1. Method of Packing Radio Receiving Set AN/FRR-27

SECTION 3
INSTALLATION AND INITIAL ADJUSTMENTS

1. INSTALLATION DRAWINGS.

A list of drawings useful in connection with the installation of the equipment, and reproduced in this book, is given in table 3-1 below, together with contractor's drawing numbers and instruction book figure numbers.

TABLE 3-1. INSTALLATION DRAWINGS

ITEM NO.	SUBJECT OF DRAWING	COMCO DWG. NO.	INSTRUCTION BOOK FIGURE NO.
1.	Outline Drawing-Radio Receiver AN/FRR-27, including case, table or bench mounting feet, relay rack mounting brackets	327-R-E-501	3-6
2.	Outline Drawing—Rear Compartment including: receptacles and external connector plugs	327-R-E-501	3-6
3.	Outline Drawing—Fabrication of Coaxial Transmission Cable, using AN Type UG-21 B/U plug	327-R-E-404	3-3
4.	Outline Drawing—Fabrication of Coaxial Transmission Cable, using AN Type UG-88/U plug	327-R-E-405	3-4
5.	Photo Illustration—Radio Receiver chassis assembly and disassembly	327-R-E-807	3-5
6.	Over-all Schematic Diagram—Radio Receiver R-518/FRR-27	327-R-E-101	7-21
7.	Practical Wiring Diagram—Radio Receiver R-518/FRR-27	327-R-E-401	7-22, 7-23

2. UNPACKING THE EQUIPMENT.

a. GENERAL.—Each complete Radio Receiving Set AN/FRR-27 is shipped in a single wooden box. The items comprising a complete AN/FRR-27 equipment are listed in table 1-1.

The method of packing the equipment is shown in figure 3-1. The receiver is separated from the walls of the fiberboard carton by suitable fiberboard air cushions. The two angle brackets, provided for use when the rereceiver is to be mounted in a relay rack, are inserted in the void of the top air cushion. The test cable (W601) which is used to connect the receiver chassis with the rear compartment of the receiver case, during alignment (see figure 7-2), is packed under the rear compartment. Three connector plugs, provided for use on external audio, power, and antenna cables are included in a separate box. Two copies of the instruction book, wrapped in a separate package, are packed on top of the top air cushion.

The inner carton is placed inside a second carton and separated from it by a moisture-vapor-proof barrier. The outer carton is placed inside the wooden box, separated from it by a waterproof box liner. The moisture-vapor-proof barrier and the waterproof box liner are heat sealed at the time the equipment is packed for shipment.

To unpack the equipment, proceed as follows:

1. Cut the two metal bands that bind the box; and remove the top panel of the box, using a nail puller.
2. Cut open the waterproof box liner.
3. Break sealing tape and open the outer fiberboard carton.
4. Cut moisture-vapor-proof barrier between outer and inner carton.
5. Break sealing tape and open the inner fiberboard carton.
6. Lift out instruction books.
7. Lift out top fiberboard air cushion.
8. Remove relay rack mounting brackets from void space in this air cushion.

9. Locate and remove the box containing three connectors.

10. Remove silica gel bags from recesses inside fiberboard air cushion.

11. Lift out receiving set, and test cable from under the rear compartment.

b. MECHANICAL CHECK.—The equipment should be inspected for possible damage or disarrangement during shipment. Check to see that no nuts, washers, bits of solder or other foreign particles have become lodged where they might cause a short circuit. Tighten any screws or nuts which may have worked loose. A careful search should also be made for broken wires and loose connections since a detailed mechanical inspection at this time may save much inconvenience in the long run. All mechanical controls on the front panel should be operated in each position, or through their full range of travel, in order to detect any bent shafts or other evidences of abnormal operation. Check to see that all tubes are undamaged and are firmly seated in their sockets; that all tube shields are firmly in place; that fuses F301 and F302 (see figure 5-1) are in their holders and a spare fuse is in place near them. Be sure the plug-in electrolytic capacitor assembly is properly seated in its octal socket.

3. INSTALLATION.

a. LOCATION OF EQUIPMENT.—In locating the receiver, consideration should be given to the accessibility of a 105, 115, or 125 volt, 50-60 cycle power source; the antenna transmission line, local and remote speaker lines, and any supplemental equipment to be employed. Clearances should be adequate to permit removal of the receiver chassis from the case and provisions should be made to allow alignment and servicing of the chassis within the five foot limitation of the case-receiver test cable (W601). Sufficient clearance should be available at the rear of the cabinet to provide access to the rear compartment and connecting cables. (See figure 3-6).

b. TABLE OR BENCH MOUNTING.—The receiver is mounted by removing the chassis from the case; marking and drilling mounting holes on the table or bench; reinstalling the chassis in the case; and then fastening the feet to the table. First unscrew the four large slotted Simmons fastener screw heads, at the extreme corners of the front panel, one-quarter turn each. Then pull the chassis out until the latches on the sides prevent further movement. Press the side latches down with the thumbs while holding the chassis with the fingers and withdraw the chassis from the case. Remove the mounting feet and using the case as a template, mark the table with a scribe through the four mounting holes on 11 X 15-7/8 inch centers and drill four 5/16 inch holes through the bench. Replace mounting feet.

Mount the case to the bench by four 1/4-20 machine screws and lock washers inserted from the underside of the bench. Slide the chassis back into the case, lifting the latches to clear the chassis stops.

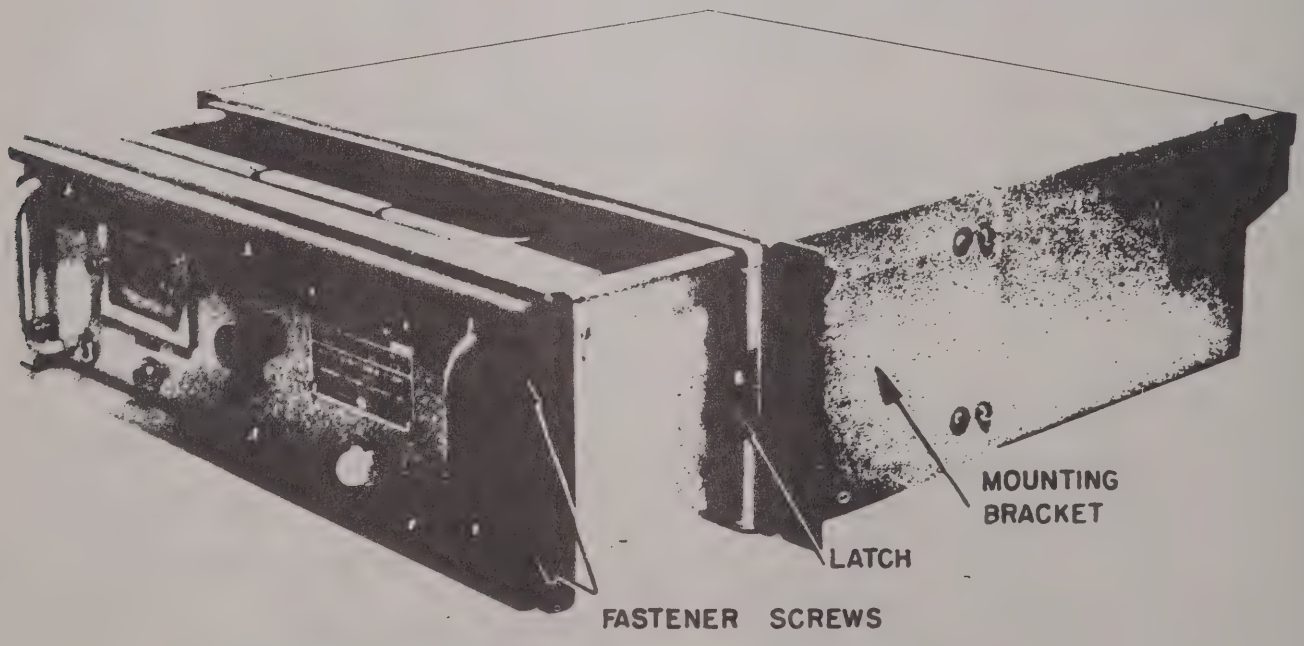


Figure 3-2. Relay Rack Mounting, Cabinet Side Lock Operation

TABLE 3-2. CONNECTORS (PLUGS) SUPPLIED WITH AN/FRR-27 EQUIPMENT FOR MAKING EXTERNAL CONNECTIONS

PLUG SYMBOL	SYMBOL OF MATING RECEPTACLE	CIRCUIT IN WHICH USED	PLUG TYPE AND/OR MFG. NO.
P501	J501	50 ohm antenna input	AN Type UG-21 B/U
P502	J502	105, 115, or 125 v, 50-60 cps power input	AN-3106A-10SL-4S
P503	J503	Audio output to local or remote speaker, headphone	AN-3106A-10SL-3S

c. RELAY RACK MOUNTING.—If the receiver is to be mounted on a standard relay rack, the table or bench mounting feet are not required and should be removed. Instead, attach the two angle mounting brackets to the sides of the cabinet, as illustrated in figure 3-2. The angle brackets are symmetrical in shape and are attached, one to each side of the cabinet, by means of four No. 10-32 thread, 5/8 in. Phillips head machine screws. These screws are shipped, already threaded into tapped holes on each side of the cabinet. These screws are nickle plated; the other screws on the case are painted. Remove the eight nickle plated screws, line up the bracket with the tapped holes and replace the screws.

d. EXTERNAL CONNECTIONS.—All external connections are brought into the receiver through the rear compartment of the cabinet (see figure 1-3). No connecting external cables are supplied with the AN/FRR-27 equipment, other than the 6 ft W601 test cable; but connectors (plugs) for the receptacles of the rear compartment are provided. A method of assemblying the two coaxial antenna plugs and cables is shown in figures 3-3 and 3-4. The types and functions of all three plugs are summarized in table 3-2. A suitable earth ground should be available for connection to the rear compartment GND bolt.

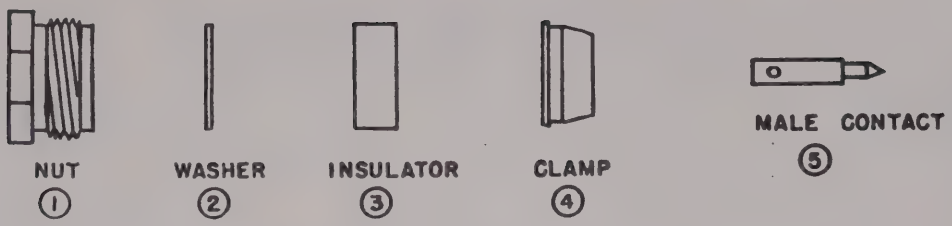
e. PREPARATION FOR OPERATION.

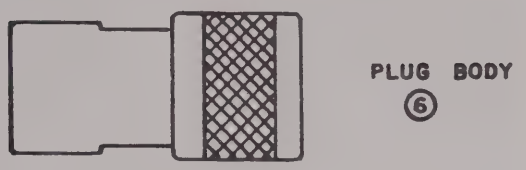
(1) AC INPUT.—The AC power input enters the receiver rear compartment through connectors P502 (plug) and J502 (receptacle). After passing through a low pass filter, which attenuates all frequencies between 2 and 200 Mc, the two leads pass from the rear compartment to the Audio/Power Supply chassis through connectors J504 and J302. This latter connection is made when the receiver chassis slides into its case and J302 of the chassis engages J504 which is mounted inside the case, at its rear. Before connecting the external AC cable to the power source, remove the receiver chassis (see figures 3-2 and 5-1), and check that fuses F301 and F302 (1 amp. 250 volt type 3AG slow blow) are in their respective fuseholders on top of the Audio/Power Supply sub-chassis. Next, measure the AC line voltage. Locate the AC switching terminal board (see figure 2-12) on the bottom of the Audio/Power Supply sub-chassis; loosen the screw holding the swinging link and place the opposite end of this link under the screw-head which most closely matches the available voltage. This procedure serves to match the available voltage to the proper taps of the power transformer (T301) primary winding. Tighten all screws on the terminal board.

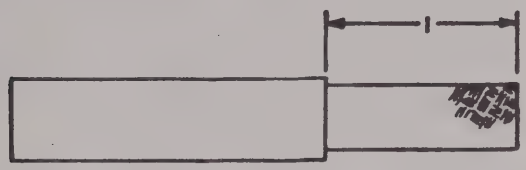
(2) AUDIO OUTPUT.—Receptacles are provided on the receiver rear compartment to feed the audio output to a local and/or remote speaker (or headphones). Both sides of the line pass through filters in the rear compartment which attenuate all frequencies between 2 and 200 Mc. The output transformer (T302) has two secondary windings (see table 7-16). One 600 ohm winding permits a portion of the audio output to be fed to the PHONE jack (J401) on the front panel to permit monitoring the audio from that point. The second winding, which is 300 ohms (center tap grounded), provides audio output for the local and/or remote speakers, and connects to receptacle J302. By the use of inverse feedback in the output circuit, the load across this winding may vary from 200 to 600 ohms, with negligible change of audio output. The audio level for the remote as well as the local speaker is regulated by the AF LEVEL control (R301) but if additional control of this level is desired at the remote point, a 600 ohm T-pad may be installed to provide the necessary variation.

(3) 50 OHM ANTENNA INPUT.—The antenna input enters the receiver through the coaxial connectors P501 and J501. In the rear compartment, a short length of coaxial transmission line permanently connects J501 to J504, the latter connector engaging J302 of the receiver Audio/Power Supply sub-chassis. A short length of coaxial line (see figure 1-4), permanently connected to the antenna terminal of J302, bridges between the Audio/Power Supply sub-chassis and the RF sub-chassis, and a bayonet type plug, P301 (AN Type UG-88/U) provides connection to the RF antenna receptacle, J101. All of these connections should be checked, prior to placing the equipment into operation, to be sure of proper continuity.

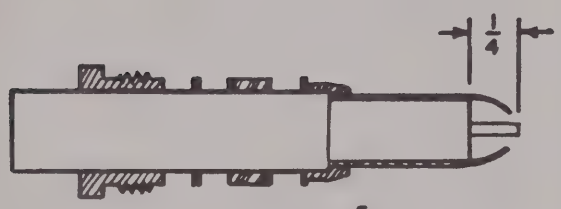
(4) CRYSTAL COMPUTATION.—The AN/FRR-27 receiver requires two type CR 23/U crystals, (see figure 1-4). One 20 Mc crystal (Y101) is supplied with the equipment and is used with the first IF amplifier as a crystal oscillator, beating against the 23 Mc IF signal to produce the second IF of 3 Mc. Check to see that this crystal is in place and tight in the crystal socket.



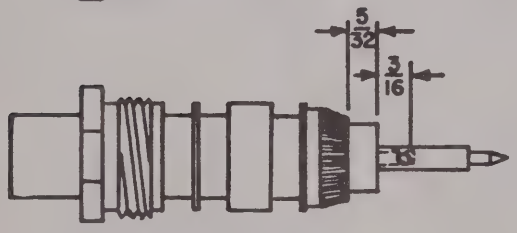




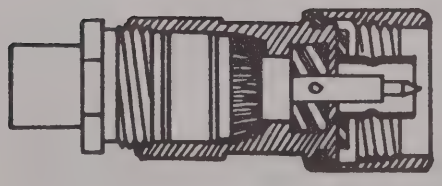
Cut Vinylite jacket square and even 1" back. Be careful not to nick or cut braid wires.



Push back braid; cut off 1/4" of cable dielectric. Pull braid forward and taper. Assemble on cable parts 1. 2, 3 and 4, being sure part 4 clears all braid wires and rests internal shoulder squarely against Vinylite jacket.

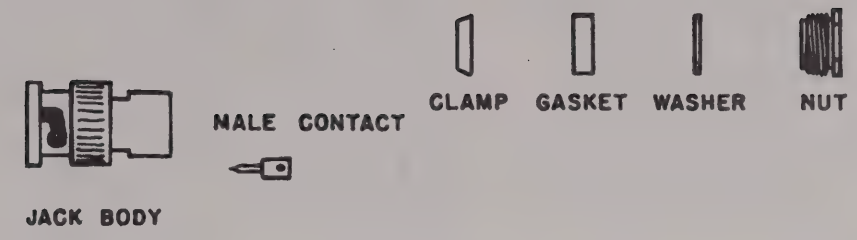


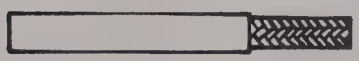
Comb out braid, fold back smoothly and trim as shown. Cut off dielectric square and even 5/32" from folded back braid, without nicking center conductor. Cut center conductor 3/16" long and tin. Solder contact in place, removing excess solder. Do not get solder or flux on dielectric.



Push assembly into body as far as it will go. Slide nut into body and tighten with wrench, holding cable and body rigid and rotating nut only.

Figure 3-3. Method of Assembling AN Type UG-21 B/U Plug to AN Type RG-8/U Transmission Line

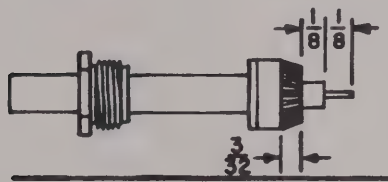




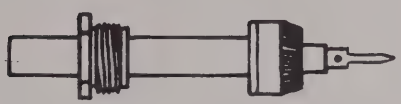
Trim jacket 1/4" for RG-58A/U, 5/16" for RG-59/U or 7/16" for RG-71/U.

Fray shield and strip inner dielectric 1/8". Tin center conductor.

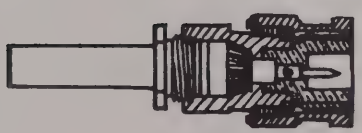
Taper braid and slide nut, washer, gasket and clamp over braid. Clamp must rest inner shoulder squarely against end of cable jacket.



With clamp in place, comb out braid, fold back smoothly and trim as shown, 3/32 from end.



Slip contact in place, butt against dielectric and solder. Remove excess solder from outside of contact. Be sure cable dielectric is not heated excessively and swollen so as to prevent dielectric from entering into connector body.



Push assembly into body as far as it will go. Slide nut into body and screw in place with wrench until tight, holding cable and shell rigid and rotating nut.

Figure 3-4. Method of Assembling AN Type UG-88/U Plug to AN Type RG-58 A/U Transmission Line

The second crystal Y102 (not supplied with the equipment) determines the incoming signal frequency to which the receiver will respond. As this receiver is a single channel, crystal-controlled type, it is necessary that this frequency-determining crystal be changed each time a different incoming frequency is to be received. Also, each time this crystal is changed, it is necessary to retune the four RF Amplifier coils (Z101, Z102, Z103 and Z104), the two Frequency Multiplier coils (Z105 and Z106), and the oscillator tuning coil (Z107).

Complete instructions for determining the proper crystal frequency and alignment of the above coils are given in SECTION 7, paragraph 4.g-i.

The receiver's operating frequency should be marked on the card on the front panel. Ink or pencil can be used. The transparent plastic card material permits easy erasure of any marking. If desired, a more permanent frequency indication on a paper card can be inserted behind the transparent plastic by removing the thumb screws.

(5) SUB-CHASSIS ASSEMBLY AND DISASSEMBLY. (See figure 3-5).—The AN/FRR-27 equipment comprises a cabinet with a rear compartment built in the case; a chassis frame which includes the front panel; and three sub-chassis assemblies designed to operate as complete functional units, and fabricated so that any or all of the three may be removed and replaced without unsoldering any leads. Connections between units are made through plug-in connector assemblies mounted on the frame shelf. This arrangement permits removal of defective assemblies and replacement by nontechnical personnel. The sub-chassis assemblies are removed by unscrewing the four hold-down screws, one at each corner on the top of the assembly. The unit can then be pulled up and out of the frame assembly. Replacement is accomplished by dropping the new unit into its proper location and replacing the screws.

Each unit will mesh properly with the plug-in connector of the frame shelf. Check that all hold-down screws are tight.

4. INITIAL ADJUSTMENTS.

When installation is complete, and all checks made as outlined in the previous paragraphs, the receiver is ready for installation adjustments. For complete information concerning the panel and sub-chassis controls functions and locations, consult the OPERATION SECTION 4, paragraph 3, and figures 4-1 and 4-2. Then proceed as follows:

a. Remove the receiver from its case. To do this, unscrew the four large slotted screw heads at the extreme corners of the panel one-quarter turn each. Pull the chassis out until the side latch stops prevent further movement. Pressing down the two latches (see figures 3-2 and 5-2), which protrude through the front of the chassis front panel frame assembly with the thumbs, will release the locks and the chassis may be pulled completely out of the case. Connect the chassis to the case by use of the 6 ft W601 test cable (see figure 7-2). This cable has plugs at each end which will mate with the receptacles of the case and receiver chassis.

b. Throw the POWER switch (S401) ON and observe that the panel indicator lamp is on. Allow the equipment to warm up for 2 or 3 minutes. As it warms, noise may or may not be heard in the local speaker, depending on the setting of the SQUELCH threshold control, R216.

c. If no noise or signal is heard, press the SQUELCH test button on the front panel. A hiss or rushing signal should be heard in the local speaker, indicating that the receiver and the squelch circuit are operating.

d. Wait until a transmitted signal is heard, then adjust the AF LEVEL control (R301) for desired audio level in the local speaker. Note that, with this control at maximum (clockwise) and a 200 to 600 ohm load on the receiver, a strong input signal will produce an audio output in excess of 2 watts, with a high percentage of distortion. Therefore, it is desirable to keep this control below 70 per cent rotation which will permit audio output levels of 1 to 1.5 watts, with low distortion on the average signal. This AF LEVEL control is also used to adjust the audio level when the equipment is connected to a remote speaker (or headphone). By the use of inverse feedback in the audio output circuit, it is possible to use one or more speakers simultaneously, provided the total load remains within 200 to 600 ohms, without more than 2 db change in output level.

e. Check the noise LIMITER switch (S201) by switching it ON and OFF. Normally this switch is ON and, in this position, limits or clips all output from the detector in excess of 60 per cent modulation, particularly all noise peaks exceeding this level. It is especially effective on sharp pulsed noise which is slow in repetition rate. When the noise limiter is switched ON, the audio power is reduced by about 1 to 1.5 db. This switch is thrown to the OFF position for all alignment.

f. The SQUELCH threshold control (R216) adjustment will be dependent upon the conditions under which the station will operate. This control permits adjustment of the squelch threshold between the limits of approximately 1 to 100 microvolts. When retarded to the maximum counterclockwise position, the receiver should be unsquelched and noise should be present in the speaker or headphones when no transmitter signal is present. As the control is rotated in a clockwise direction, a point will be reached where the squelch will close and no audio will be heard in the absence of a transmitter signal. When the control is left at this point, which is its most sensitive setting, the signal

strength required to open the squelch will be approximately 1 microvolt or less. If the control is set at maximum clockwise rotation, the signal required to open the squelch will be over 100 microvolts. For best operation, the squelch should be adjusted to the point where the receiver is just quiet. Should a more sensitive setting be desired, the control may be retarded until slight noise pulses may occasionally come through. If the receiver is operating close to the transmitter, and quietness of operation is desired rather than high sensitivity, the SQUELCH may be advanced clockwise past its sensitive point, so that distant signals will not trigger the action and only the desired strong signal comes through.

g. This completes the initial adjustments, and the receiver should now be ready for regular operation. If during any of the previous adjustments, it appears that the equipment is not performing properly, it is advisable to make the suitable audio or sensitivity check, as outlined in SECTION 7, paragraph 5. If these checks indicate some malfunctioning, corrective measures should be taken as described in SECTION 7, CORRECTIVE MAINTENANCE.

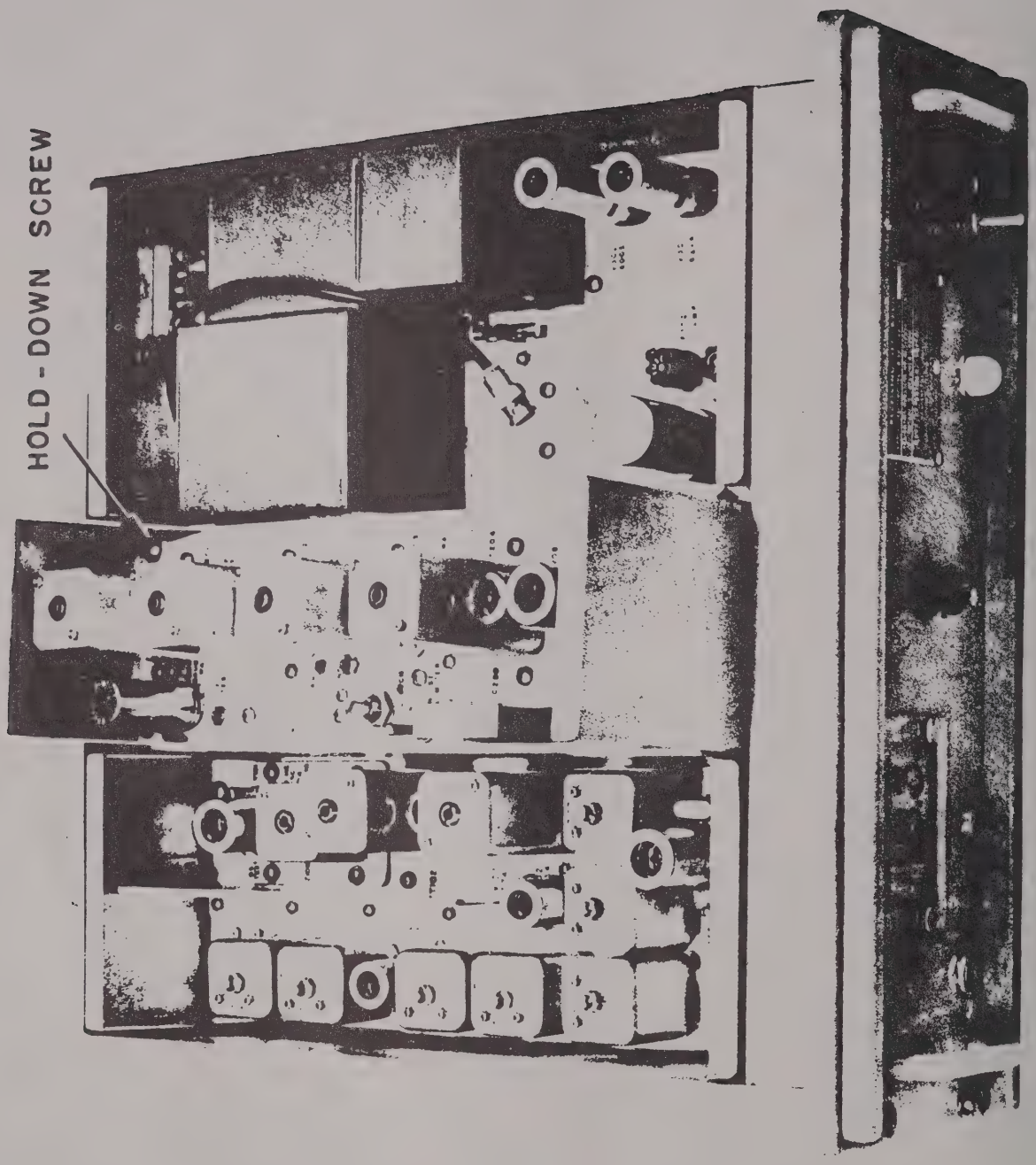
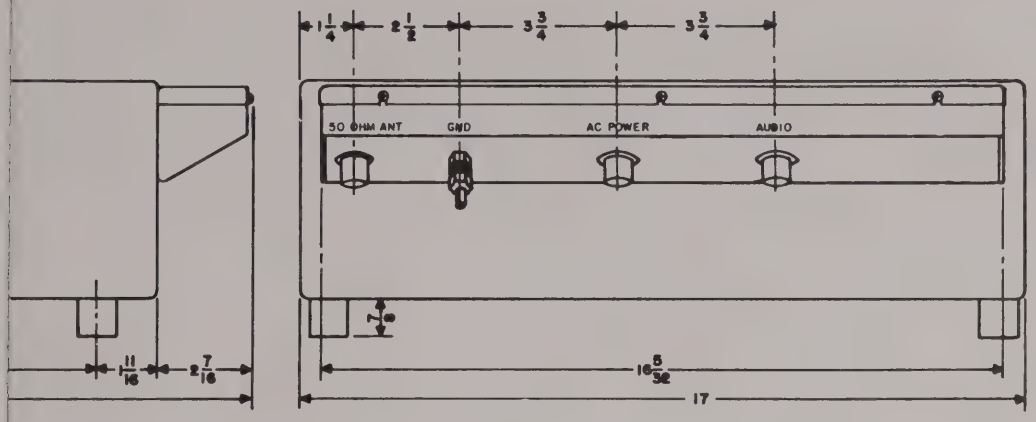
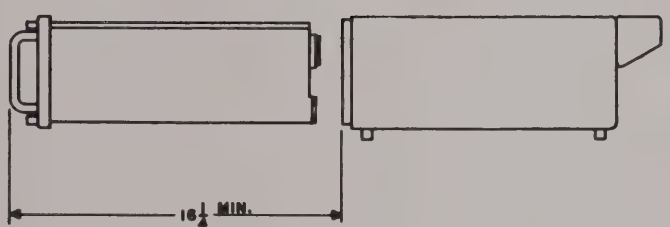


Figure 3-5. Receiver Chassis Assembly, Disassembly



OUNTING
REWS (4)



DISTANCE REQUIRED TO
REMOVE CHASSIS FROM CABINET

ACK
T

ED)

TS

Figure 3-6. Outline, Radio Receiver, Panel, Case, Relay Rack Mtg Brackets, Bench Mounting Feet

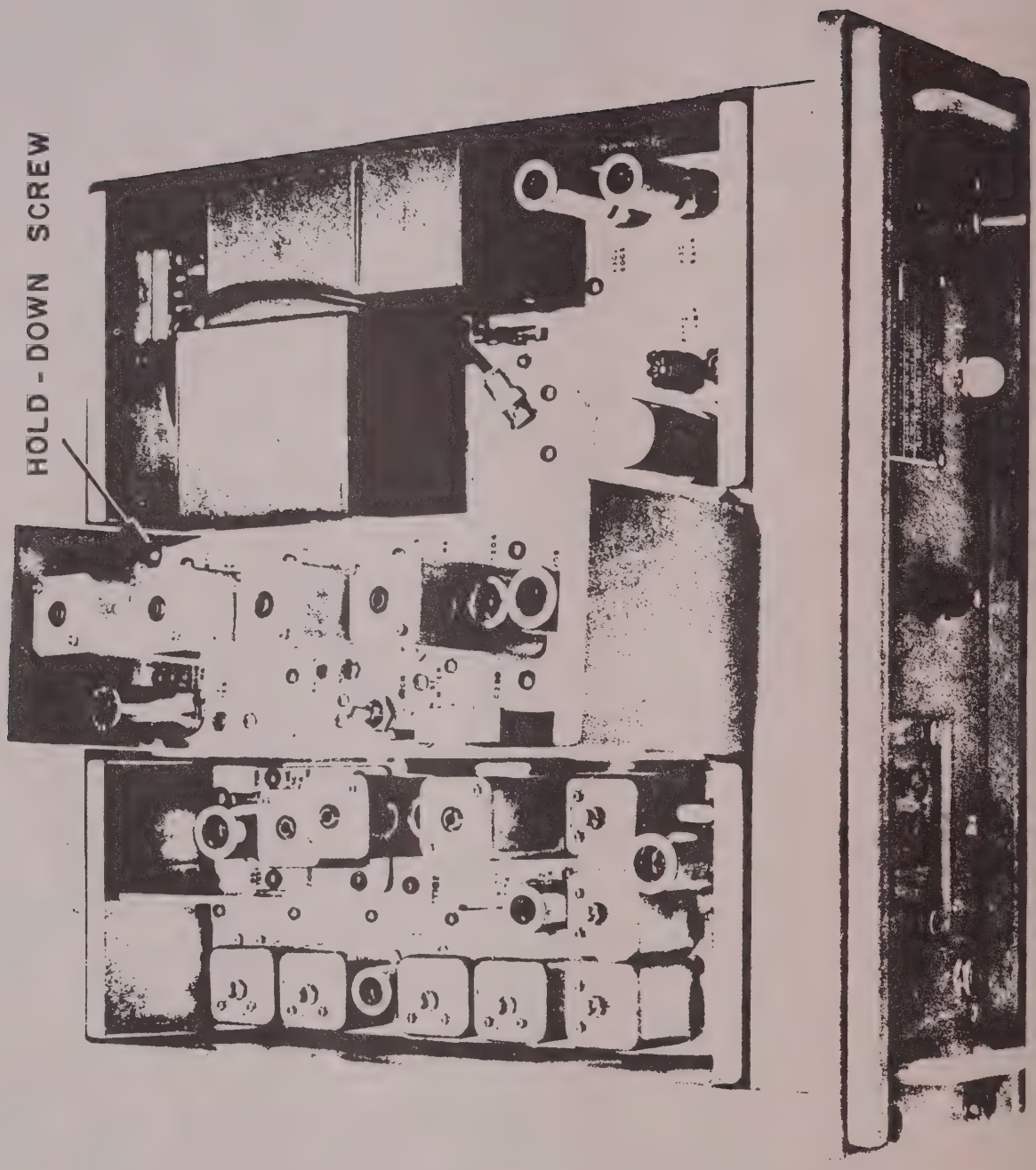


Figure 3-5. Receiver Chassis Assembly, Disassembly

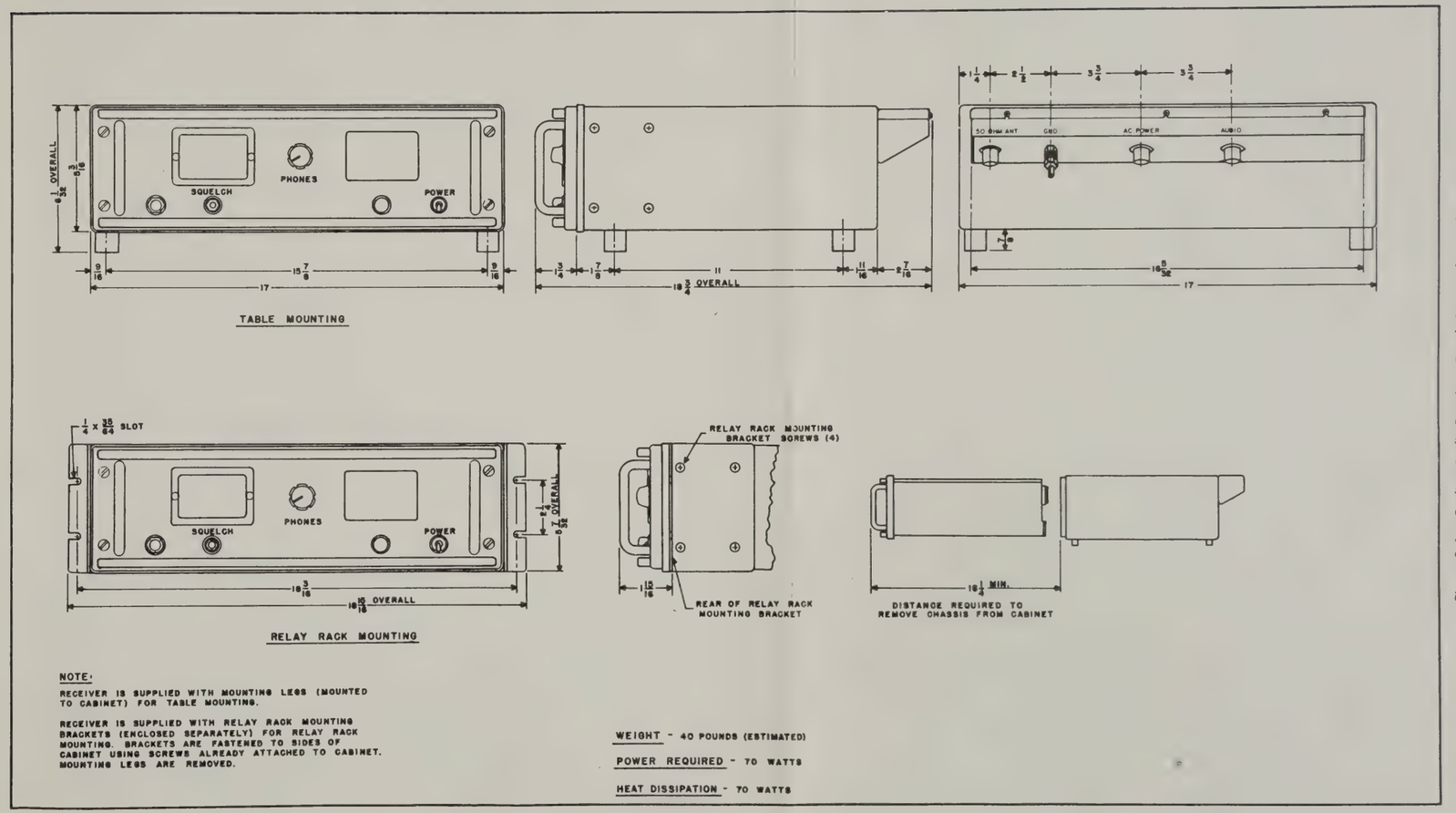
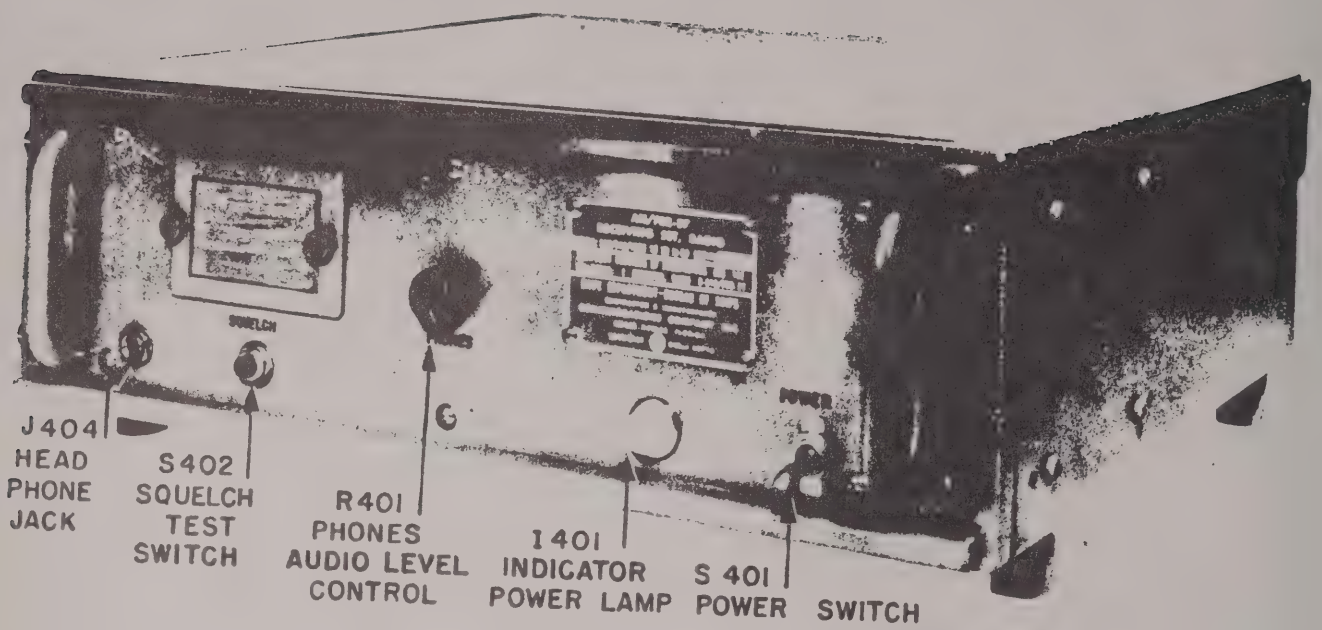

SQUELCH
PHONES
POWER
OVERALL
50 OHM ANT
GND
AC POWER
AUDIO
TABLE MOUNTING
SLOT
RELAY RACK MOUNTING
BRACKET SCREWS (4)
REAR OF RELAY RACK
MOUNTING BRACKET
DISTANCE REQUIRED TO
REMOVE CHASSIS FROM CABINET
RELAY RACK MOUNTING
NOTE:
RECEIVER IS SUPPLIED WITH MOUNTING LEGS (MOUNTED TO CABINET) FOR TABLE MOUNTING.
RECEIVER IS SUPPLIED WITH RELAY RACK MOUNTING BRACKETS (ENCLOSED SEPARATELY) FOR RELAY RACK MOUNTING. BRACKETS ARE FASTENED TO SIDES OF CABINET USING SCREWS ALREADY ATTACHED TO CABINET. MOUNTING LEGS ARE REMOVED.
WEIGHT - 40 POUNDS (ESTIMATED)
POWER REQUIRED - 70 WATTS
HEAT DISSIPATION - 70 WATTS

Figure 3-6. Outline, Radio Receiver, Panel, Case, Relay Rack Mtg Brackets, Bench Mounting Feet

NOTES



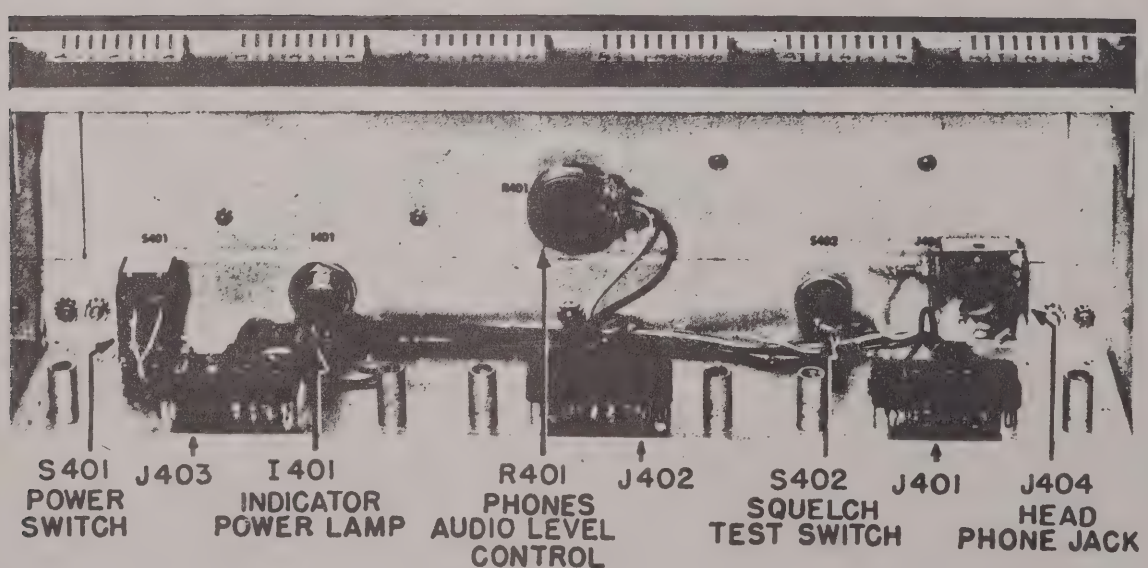


Figure 4-1. Radio Receiver, Front Panel

SECTION 4
OPERATION

1. INTRODUCTION.

The AN/FRR-27 single-channel receiver, designed for amplitude-modulation reception, is a crystal-controlled, dual-conversion superheterodyne, operating in the frequency range of 100 to 156 Mc. It comprises an RF amplifier; a frequency-determining oscillator/multiplier; a first IF amplifier and crystal oscillator section; a three-stage second IF amplifier; a detector; three stages of audio amplification and a multiple impedance output with provisions for local and/or remote speakers (or headphones). Special circuits provide noise limiting, automatic gain control, and squelch control. Monitoring is possible by use of the front panel phone jack and headphone control. The receiver is designed for continuous operation over long periods of time with a minimum of attention.

2. PRELIMINARY.

It is assumed that, before being assigned to the operating personnel, the AN/FRR-27 equipment will have been installed and all necessary adjustments made according to instructions given in Section 3. These adjustments include, not only the alignment of the various sections, but also the squelch, noise limiting, and audio level settings. For the benefit of operators, who are technically qualified, the following paragraphs include instructions for proper adjustment of these sub-chassis controls. It will be noted that since this receiver is of single-channel design, a change in operating frequency requires a change in the Frequency Determining Crystal (Y102) and realignment of the RF and Frequency Determining sections. This realignment will require special test equipment and should be performed only by qualified technicians in accordance with instructions of Section 7.

3. DESCRIPTION AND LOCATION OF CONTROLS.

a. PANEL CONTROLS.—These controls are used for turning the receiver ON or OFF, monitoring the audio output, and squelch testing. Their locations are indicated in figure 4-1.

(1) POWER INDICATOR LAMP (I401).—This is a neon lamp indicator which is operated from the B+ supply of the receiver.

(2) SQUELCH TEST SWITCH (S402).—This is a momentary operated push button switch, used to disable the receiver squelch or to receive signals which are too weak to open the squelch. The switch is normally closed. If the squelch threshold control (R216) (on the IF sub-chassis) has been adjusted to a point where the squelch is always open, the SQUELCH test switch (S402) will have no effect.

(3) PHONES AUDIO LEVEL CONTROL (R401).—This control is used to adjust the level of audio output at the headphone jack. When 600-ohm phones are used, the power level can be controlled in a range of over 30 db. The headphone level is increased when the control is turned in a clockwise direction.

(4) HEAD-TELEPHONE JACK (J404).—This jack is provided so that a pair of 500 to 600 ohm phones can be plugged in, for monitoring the receiver. When the PHONES level control is set at maximum level (clockwise), the audio output from the headphone jack will be about one per cent (1/100) of the power delivered to the AUDIO (J503) receptacle, when its load equals 600 ohms. Accordingly, when the receiver is delivering 1.5 watts into a 600-ohm load, the maximum audio available at the headphone jack is 15 milliwatts into 600-ohm phones.

(5) POWER SWITCH (S401).—This switch controls the AC power input to the receiver. It is OFF in the down position.

b. CHASSIS CONTROLS.—These controls, located on the IF and Audio/Power Supply sub-chassis, as indicated in figure 4-2, permit adjustment of various receiver functions and should not require readjustment after initial installation, unless a change in operating conditions is required. These changes should be performed only by qualified personnel.

(1) NOISE LIMITER SWITCH (S201).—This switch is used to turn the noise limiter action ON or OFF, as desired. Normally the switch is ON, and, in this position, it limits or clips all output from the detector in excess of 60 per cent modulation, particularly all noise peaks exceeding this level. When the noise limiter is switched ON, the audio power is reduced by about 1 to 1.5 db.

(2) SQUELCH THRESHOLD CONTROL (R216).—This control permits adjustment of the squelch threshold. When the control is retarded to the maximum counterclockwise position, the receiver should be un-

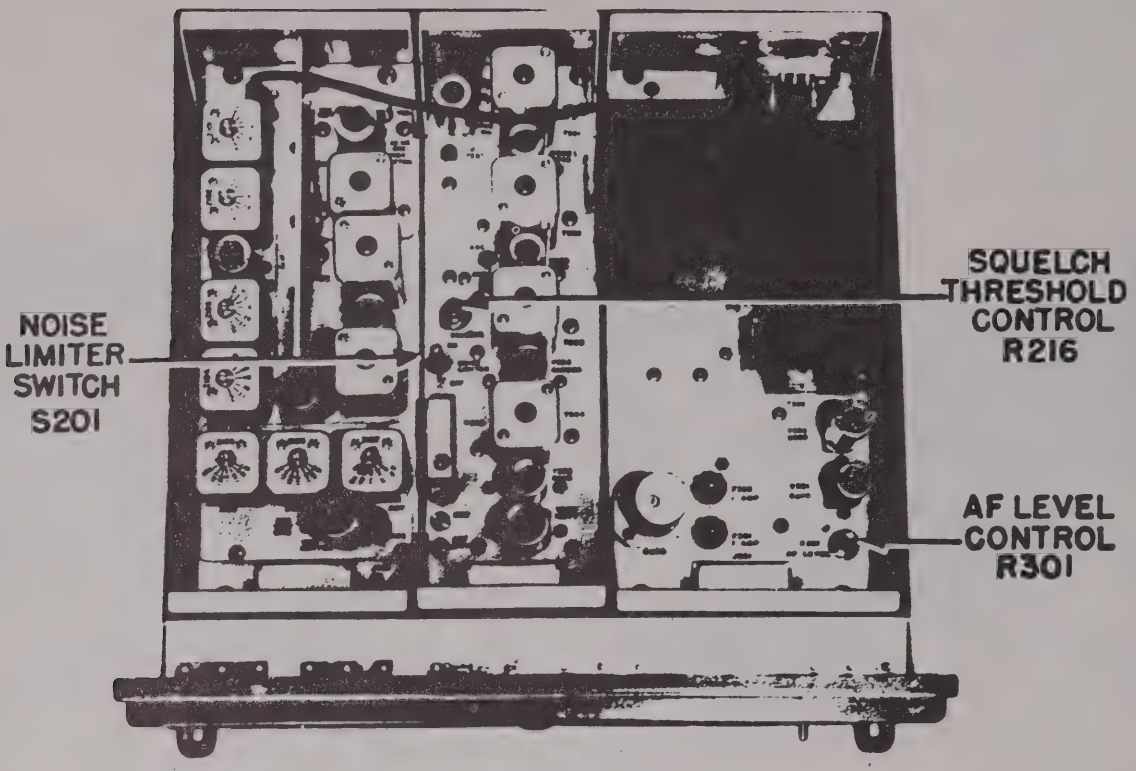


Figure 4-2. Receiver Chassis Controls

squelched and noise should be heard when no signal is present. If the control is rotated in a clockwise direction, a point will be reached where the squelch will close and no audio will be heard, providing no signal is present. When the control is left at the point where the squelch has just closed, and the receiver is quiet, it will be at its most sensitive setting. If the control is advanced further clockwise, an increasingly stronger signal is required to open the squelch, making the receiver less sensitive but more adaptable to operation relatively close to the transmitter, or in an area of excessive noise.

(3) AF LEVEL CONTROL (R301).—This control is used to adjust the audio level for all of the receiver outputs; including the audio receptacle (J503) and the panel headphone jack (J404). With this control set at maximum clockwise and a proper load on the receiver, the output produced by a strong signal will be in excess of 2 watts with a high percentage of distortion. It is desirable, therefore, to keep this control below 70 per cent rotation to keep distortion at a minimum.

4. MODES OF OPERATION.

a. TUNING.—As the AN/FRR-27 Radio Receiver is designed for single-channel, crystal-controlled operation, it is not possible to change the operating frequency excepting by a change of the frequency-determining crystal (Y102) and retuning of the RF stage and frequency-determining crystal oscillator/multiplier stage. Such changes in frequency require proper test equipment and should be performed only by qualified technicians.

b. LOCAL AND REMOTE OPERATION.—The terms "LOCAL" and "REMOTE" pertain to the distribution of audio output from the receiver and are not to be construed as meaning that all functions of operating and adjustment may be performed by remote control. All operating controls are on the front panel; additional controls to be used for adjustment of noise, squelch, and audio are on sub-chassis; but none are operative from the remote position.

5. OPERATING THE RECEIVER.

a. LOCAL OPERATION.—After initial installation and alignment has been completed, as outlined in Sections 3 and 7, the receiver is placed into local operation as follows:

(1) Check to be sure that a 200 to 600 ohm speaker has been connected to the AUDIO receptacle (J503). A head-telephone set may be plugged into the jack on the front panel for monitoring, but a 200 to 600 ohm load, consisting of either a speaker or a resistor should always be across the AUDIO receptacle during local operation.

(2) Inspect cables entering the back panel to ascertain that all are in place and the connectors screwed tight.

(3) Unscrew one-quarter turn each of the four fasteners on the front panel, and pull the chassis partially out of its case, by means of the handles mounted on each side of the panel. Check that the two crystals are in place (both are on the RF sub-chassis). All tubes should have their shields locked in place. Return the chassis inside the case, and tighten the fasteners.

(4) Throw the POWER Switch (S401) on the front panel to ON. Allow the receiver to warm up for 2 or 3 minutes. The panel lamp should light, indicating B+ power in the equipment. Providing the SQUELCH threshold control has been correctly adjusted, the receiver should remain quiet, excepting when a transmitted signal is received. The transmitter signal should come through clearly and complete, without chopping of the first part of the message. As the transmission ends, the receiver should cut off cleanly and should remain quiet until again activated by the transmitter signal. If a head-telephone set is used, adjust the volume with the PHONES control.

(5) Squelch operation may be checked by means of the squelch test switch on the front panel. Pushing this switch disables the squelch action and permits operation of the audio amplifier. As this button is pressed, a "hiss" should be heard in the speaker or monitoring headphones, indicating normal receiver noise. In the event that the squelch has been adjusted for local reception, requiring an extremely strong signal to cause it to open, the SQUELCH test switch may be used to disable the squelch circuit to permit reception of distant station(s).

b. REMOTE OPERATION.—Assuming that all audio level adjustments have been completed as outlined in Section 3, the operation at a remote point involves only listening to the audio output. Normally, the volume level for the remote point is adjusted by installation technicians by means of the AF LEVEL control (R301) on the Audio/Power Supply sub-chassis. If required, an additional control may be installed at the remote end of the audio line to permit closer control of audio level at that point. The remote line may be monitored at the receiver location, by means of 200 to 600 ohm headphones plugged into the PHONES jack on the front panel. A headphone level control is provided on the front panel for the monitor's use.

SECTION 5
OPERATOR'S MAINTENANCE

1. GENERAL.

Although maintenance of a radio equipment is primarily the responsibility of technical personnel, it is nevertheless essential that the operator keep watch over his equipment during use, in order that minor defects may be discovered, and either corrected or reported before major trouble develops.

It is suggested that the routine operational check outlined below be made at the beginning of each watch, or when operation is resumed after more than 6 to 8 hours of idleness.

2. ROUTINE OPERATIONAL CHECK CHARTS.

The checks tabulated in table 5-1 should be made hourly during operation and at the beginning of each watch.

3. EMERGENCY MAINTENANCE.

a. GENERAL.—In addition to making the routine checks, previously outlined, the operator should be sufficiently familiar with his equipment to be able, in an emergency, to rectify minor damage or disarrangements which might develop during battle or other periods of emergency, when technical aid is not immediately available. Since, under such conditions, tube and fuse failures will be most likely and the most frequent causes of trouble, the information in the following paragraphs is provided to enable operating personnel to locate and replace these components, as required.

Notice To Operators

Operators shall not perform any of the following emergency maintenance procedures without proper authorization.

b. FUSE INFORMATION.—Two 1-ampere, type 3AG slow-blow glass cartridge fuses, located on the top of the Audio/Power Supply sub-chassis as indicated in figure 5-1, are the only fuses used in Radio Receiver AN/FRR-27. These fuses protect the 105/115/125 volt, 50-60 cycle primary circuit. Access to the fuses is obtained by unscrewing the four fasteners in the corners of the front panel, and pulling the entire unit out of the case until the side latches prevent further movement. The fuses are removed by pushing down on the fuseholder head, then twisting it one-quarter turn in a counterclockwise direction. The fuseholder head, with the fuse attached may now be lifted up. Condition of the fuse may be determined by observing through the glass casing whether the fuse link has been broken or melted. Always replace a bad fuse with one of exactly the same rating and, before replacing, check the set and cables visually to make certain that no obvious fault exists. The description for these fuses is given in table 8-2 under F301.

A spare fuse is mounted in a clip next to the audio output transformer on the Audio/Power Supply subchassis, as indicated in figure 5-1. Additional spare fuses should be kept at hand for replacement use. If fuse F301 or/and F302 blow following a replacement, the primary wiring should be examined for obvious shorts. If no shorts are apparent, further servicing must be entrusted to qualified maintenance personnel.

CAUTION

Never replace a fuse with one of higher rating unless continued operation of the receiver is more important than the probable damage to it. If a

TABLE 5-1. ROUTINE OPERATIONAL CHECK CHART

WHAT TO CHECK	HOW TO CHECK	REMARKS
Neon Indicator Lamp (I-101)	Check visually to see that lamp glows when the POWER switch is in the ON position.	Failure of this lamp indicates loss of B voltage. Seldom due to failure of the lamp. Check fuses, AC input connections.
Receiver Operation	Press the SQUELCH switch button on the front panel. A noise hiss in the speaker (or headphones) should result.	The receiver is normally adjusted so that it just quiets in the absence of a transmitter signal.
External Cables and Connectors	Check connectors at rear of receiver for looseness or intermittent connection.	Loose connections may cause intermittent or noisy reception.

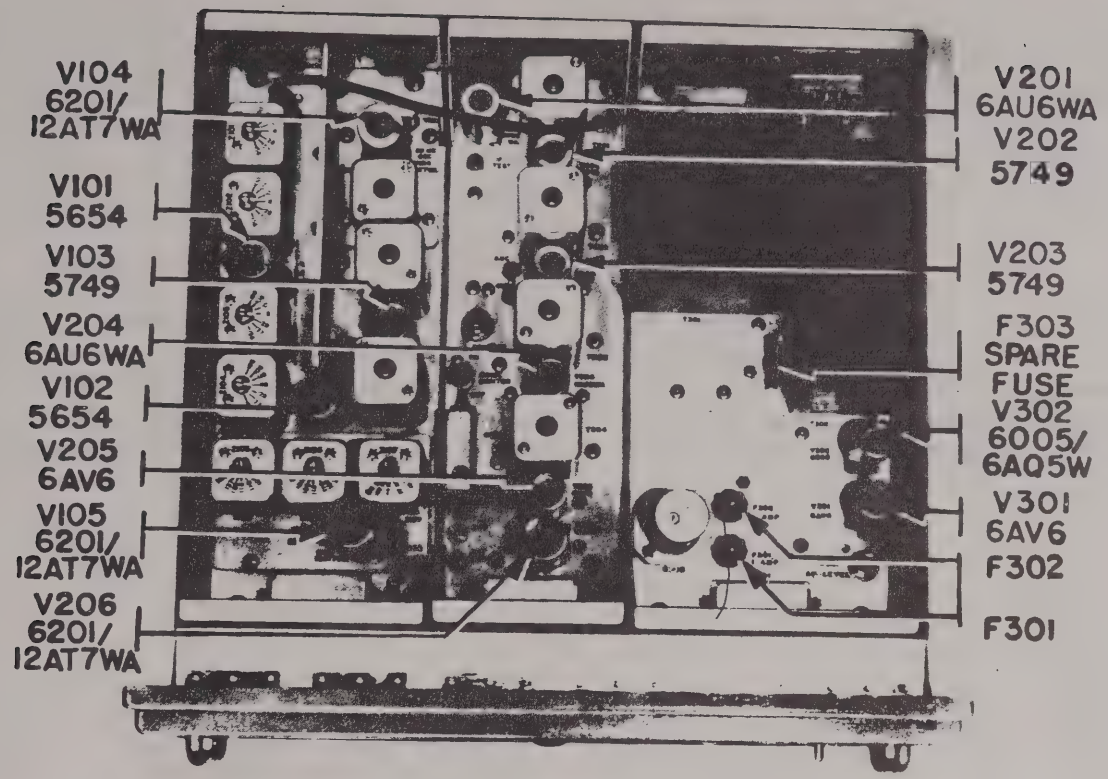


Figure 5-1. Tube and Fuse Types and Locations

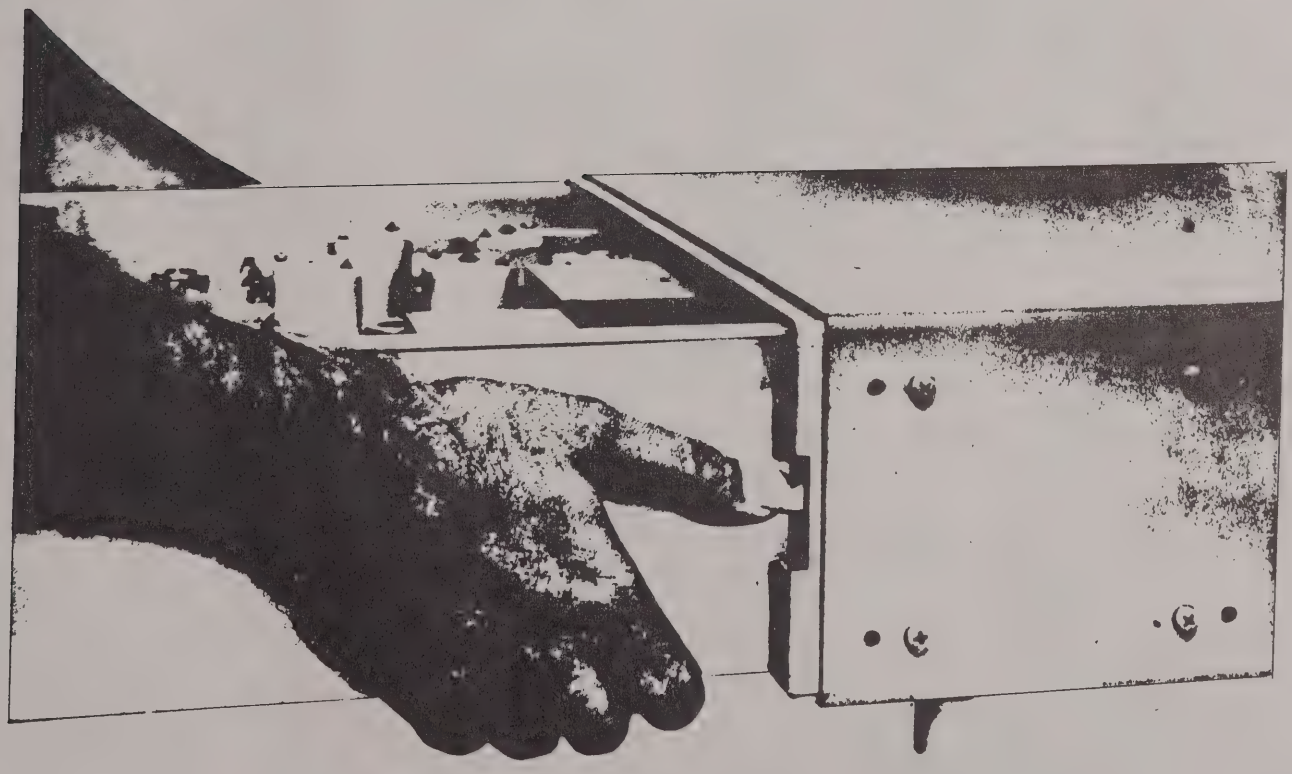


Figure 5-2. Operation of Case Side Locks

fuse burns out immediately after replacement, do not make a second replacement until the cause of the trouble has been corrected.

c. ELECTRON TUBE INFORMATION.—The full complement of electron tubes used in the AN/FRR-27 is given in table 1-4. These tubes are all located on the three sub-chassis assembly units, as indicated in figure 5-1.

To obtain access to the tubes, unscrew the four fasteners in the corners of the front panel and pull the receiver from the case as far as the mechanical stops will permit. This will permit access to most of the tubes. To check or replace the tubes at the extreme rear of the sub-chassis, the receiver must be entirely removed from the case. This can be done by pressing down on the two mechanical locks, one at each side of the case front (see figures 3-2 and 5-2) and pulling the receiver out.

If the receiver fails to operate, but the neon panel lamp remains lighted indicating the presence of B+ voltage, the cause may be attributable to tube failure. Since it will not be known which tube has failed, each tube in the receiver should be replaced with a tube known to be good (and of the same type), until the defective one is located, in the following order: first those on the audio chassis; next those on the IF chassis, and finally those on the RF chassis. Viewing these chassis from the front of the set, this order starts with the chassis on the right side and works toward the left.

SECTION 6
PREVENTIVE MAINTENANCE

1. GENERAL.

While the AN/FRR-27 equipment has been designed and built to give as continuous and trouble-free operation as possible, a certain amount of wear and deterioration must be expected in any apparatus of this nature. If detected and corrected at an early stage, trouble from these causes can be minimized, but if nothing is done until trouble actually occurs, a serious shut down may be necessary at a time when use of the equipment is most needed.

Since wear and deterioration, though they represent potential trouble, are not always evident in themselves, it is essential to continued trouble-free operation that certain vital points be inspected periodically, and the necessary replacements and adjustments be made when discovered. Such systematic inspection and adjustment will insure consistent operation, and will increase the efficiency and life of the equipment.

A practical working schedule is outlined below. However, it may be found desirable to modify this schedule as experience dictates, since the exact intervals at which certain maintenance procedures must be performed will be determined by such factors as the operating schedule of the station or ship and prevailing atmospheric conditions.

2. OVERALL INSPECTION.

An over-all inspection of the equipment is recommended as a precautionary measure immediately before being put into service, and thereafter at intervals of three or four months, the exact intervals depending upon service conditions and upon whether or not any faults have developed.

Such an inspection involves a complete examination of electrical wiring and mechanical details, and of general electrical and mechanical operation. Also any cleaning necessary to remove accumulated dirt.

Suggested routines for periodic electrical and mechanical inspection are given in the routine maintenance check charts shown below.

3. ROUTINE MAINTENANCE CHECK CHARTS.

SAFETY NOTICES

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TABLE 6-1. ROUTINE MAINTENANCE CHECK CHART

WHAT TO CHECK	HOW TO CHECK	PROCEDURE
	HOURLY, Or Every Watch	
	See "Routine Check Chart," Table	
	DAILY and WEEKLY	
	None Required	
	MONTHLY	
Receiver sensitivity and reserve gain	Check as outlined in section 7, Corrective Maintenance	If sensitivity or reserve gain is low, receiver will require tube replacement and/or alignment as outlined in section 7.
Cables and connectors	Detach cables and examine insulation for possible damage. Examine all connectors for loose, bent, or dirty contacts; also for damaged threads.	If dirt or grease on contacts, clean with carbon tetrachloride, observing necessary precautions in its use.

TABLE 6-1. ROUTINE MAINTENANCE CHECK CHART (Continued)

WHAT TO CHECK	HOW TO CHECK	PROCEDURE
Front panel and sub-panel controls	Check for looseness of switch and control mounting nuts. Check for missing or loose knobs.	Tighten loose nuts, replace missing knobs and tighten loose knobs.
QUARTERLY		
Electron tubes	Check all electron tubes in a transconductance type tube tester. Replace any tube having a transconductance value of less than 75 per cent of normal.	When replacing tubes, realignment of the circuit affected may be necessary.
ANNUALLY		
Receiver chassis and cabinet	Inspect receiver chassis, top and bottom for loose parts, assemblies and chassis assembly screws. Inspect for dirt on tube sockets, connectors, and terminal strips. Inspect cabinet for loose mounting screws. Check for damage due to overheating.	A small paint brush may be used to remove dirt from tube sockets and easily accessible points. It will be necessary to use compresed air to clean out the more inaccessible areas.

4. LUBRICATION.

No part of Radio Receiving Set AN/FRR-27 will require lubrication at any time as a preventive measure against damage to the equipment. However a little Navy type 16-L-2 grade II, medium, ball bearing lubricant applied to the bottom guide rails inside the case will facilitate removal of the chassis from the cabinet and its reinsertion.

5. RE-TROPICALIZATION.

In manufacture, the AN/FRR-27 equipments are not tropicalized as complete assemblies, but instead, use is made of materials and parts which are inherently moisture and fungus resistant. Since the repair parts provided are identical with the parts used in the equipment, the over-all resistance of the equipment to moisture and fungus should be unaffected. The terminal boards in the AN/FRR-27 equipment are made of glass cloth bakelite.

NOTES

FAILURE REPORTS

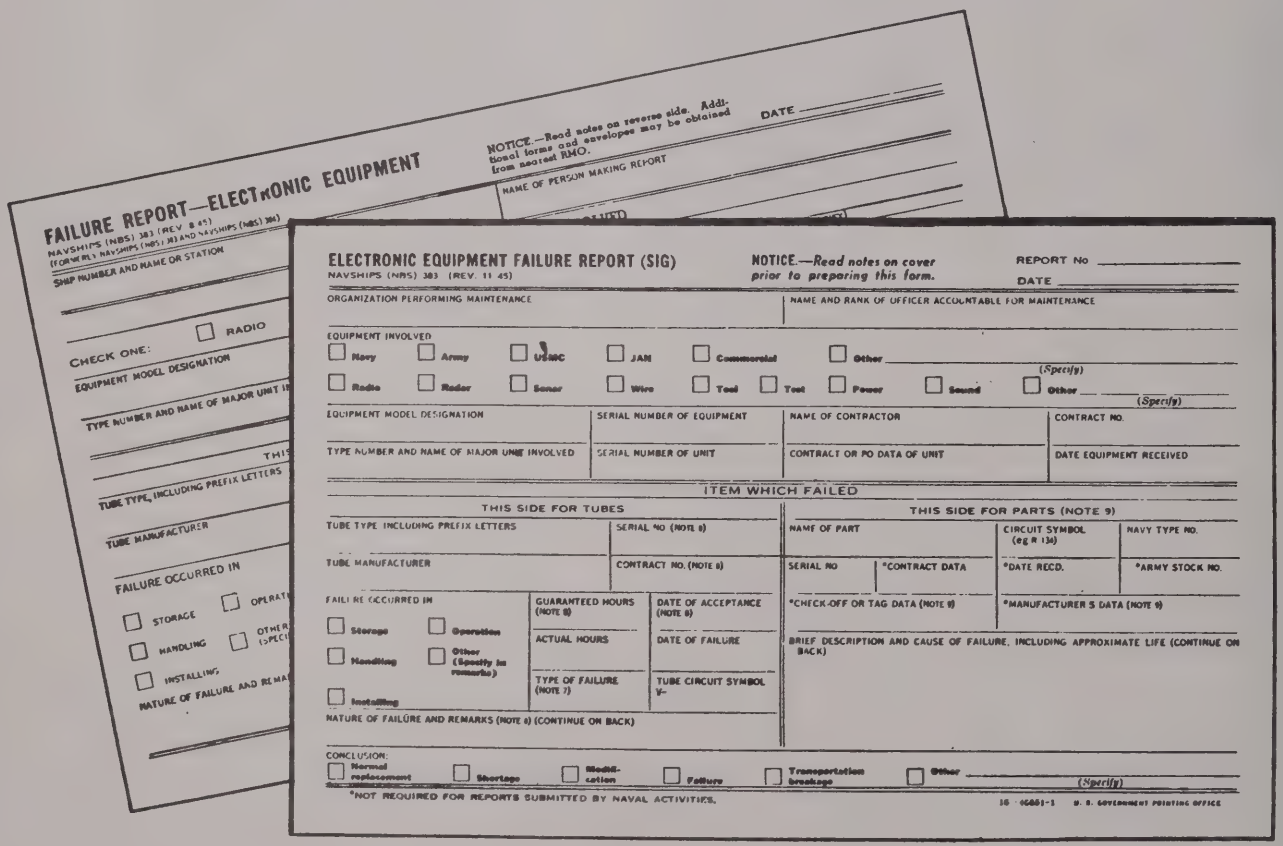
A FAILURE REPORT must be filled out for the failure of any part of the equipment whether caused by defective or worn parts, improper operation, or external influences. It should be made on Failure Report, form NBS-383, which has been designed to simplify this requirement. The card must be filled out and forwarded to BUSHIPS in the franked envelope which is provided. Full instructions are to be found on each card.

Use great care in filling the card out to make certain it carries adequate information. For example, under "Circuit Symbol" use the proper circuit identification taken from the schematic drawings, such as T-803, in the case of a transformer, or R-207, for a resistor. Do not substitute brevity for clarity. Use the back of the card to completely describe the cause of failure and attach an extra piece of paper if necessary.

The purpose of this report is to inform BUSHIPS of the cause and rate of failures. The information is used by the Bureau in the design of future equipment and in the maintenance of adequate supplies to keep the present equipment going. The cards you send in, together with those from hundreds of other ships, furnish a store of information permitting the Bureau to keep in touch with the performance of the equipment of your ship and all other ships of the Navy.

This report is not a requisition. You must request the replacement of parts through your Officer-in-Charge in the usual manner.

Make certain you have a supply of Failure Report cards and envelopes on board. They may be obtained from any Electronics Officer.



FAILURE REPORT—ELECTRONIC EQUIPMENT
NAVSHIPS (NBS) 383 (REV. 8 45)
(FORMERLY NAVSHIPS (NBS) 383 AND NAVSHIPS (NBS) 384)
SHIP NUMBER AND NAME OR STATION
CHECK ONE: RADIO
EQUIPMENT MODEL DESIGNATION
TYPE NUMBER AND NAME OF MAJOR UNIT
TUBE TYPE, INCLUDING PREFIX LETTERS
TUBE MANUFACTURER
FAILURE OCCURRED IN
STORAGE
HANDLING
INSTALLING
NATURE OF FAILURE AND REMA
NOTICE.—Read notes on reverse side. Additional forms and envelopes may be obtained from nearest RMO.
DATE
NAME OF PERSON MAKING REPORT

ELECTRONIC EQUIPMENT FAILURE REPORT (SIG)
NAVSHIPS (NBS) 383 (REV. 11 45)
NOTICE.—Read notes on cover prior to preparing this form.
REPORT No
DATE
ORGANIZATION PERFORMING MAINTENANCE
NAME AND RANK OF OFFICER ACCOUNTABLE FOR MAINTENANCE
EQUIPMENT INVOLVED
Navy Army USMC JAN Commercial Other
Radio Radar Sonar Wire Test Test Power Sound Other
(Specify)
EQUIPMENT MODEL DESIGNATION
SERIAL NUMBER OF EQUIPMENT
NAME OF CONTRACTOR
CONTRACT NO.
TYPE NUMBER AND NAME OF MAJOR UNIT INVOLVED
SERIAL NUMBER OF UNIT
CONTRACT OR PO DATA OF UNIT
DATE EQUIPMENT RECEIVED
ITEM WHICH FAILED
THIS SIDE FOR TUBES
TUBE TYPE INCLUDING PREFIX LETTERS
SERIAL NO (NOTE 6)
TUBE MANUFACTURER
CONTRACT NO. (NOTE 6)
FAILURE OCCURRED IN
Storage Operation Handling Other (Specify in remarks) Installing
GUARANTEED HOURS (NOTE 6)
DATE OF ACCEPTANCE (NOTE 6)
ACTUAL HOURS
DATE OF FAILURE
TYPE OF FAILURE (NOTE 7)
TUBE CIRCUIT SYMBOL
NATURE OF FAILURE AND REMARKS (NOTE 6) (CONTINUE ON BACK)
THIS SIDE FOR PARTS (NOTE 9)
NAME OF PART
CIRCUIT SYMBOL (eg R 136)
NAVY TYPE NO.
SERIAL NO
*CONTRACT DATA
*DATE RECD.
*ARMY STOCK NO.
*CHECK-OFF OR TAG DATA (NOTE 9)
*MANUFACTURER'S DATA (NOTE 9)
BRIEF DESCRIPTION AND CAUSE OF FAILURE, INCLUDING APPROXIMATE LIFE (CONTINUE ON BACK)
CONCLUSION:
Normal replacement Shortage Modification Failure Transportation breakage Other
(Specify)
*NOT REQUIRED FOR REPORTS SUBMITTED BY NAVAL ACTIVITIES.
16 66881-1 U. S. GOVERNMENT PRINTING OFFICE

Figure 7-1. Failure Reports Form, NBS-383

SECTION 7

CORRECTIVE MAINTENANCE

1. INTRODUCTION.

Corrective maintenance covers that phase of the care of the equipment which deals with the location and correction of trouble which has already occurred, and which is beyond the province of the operator to attempt to correct. For this work, it is assumed that technical personnel with radio training are available.

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2. TROUBLE SHOOTING.

a. GENERAL.—When properly installed, any irregularities which occur in the performance of the equipment will be attributable either to misadjustment of one or more of the controls, or to the failure of some part. In most cases, it will be possible to localize a particular fault from the general nature of the trouble encountered. Faulty or abnormal action of a particular control will often indicate the particular section of the receiver, and the specific portion of the circuit in which the trouble lies. Reference to the over-all schematic diagram of Radio Receiver R-518/FRR-27 (see figure 7-21); the simplified diagrams of figures 2-3, 2-4, 2-5, 2-6, 2-8, 2-9, 2-10, 2-11, and 2-13; and the block diagram of figure 2-1 will aid in localizing particular faults.

b. TROUBLE SHOOTING CHART.—In tracing faults, an orderly and systematic procedure should be followed. The trouble shooting chart (see table 7-12) gives the symptoms of troubles commonly encountered.

c. VOLTAGE AND RESISTANCE MEASUREMENTS.—The values of voltage and resistance from each tube socket terminal to ground and/or other significant points are summarized in table 7-13. All tube sockets, terminal boards, and connectors are readily available on the bottom of the receiver chassis and rear compartment, excepting V101 and the chassis connectors. A cover over the V101 socket must first be removed to permit access to the terminals. This cover may be removed by simply inserting the index finger underneath it and pulling upward. A minimum amount of force is required since only pressure type clips, on either side, hold the cover in place.

Special check points are available on the top of the IF and RF chassis assemblies. These test points permit voltage checks of oscillators, detector, and AGC circuits as outlined in tables 7-3, 7-5, and 7-11.

Conditions under which all of the above measurements were made are outlined in the individual tables, as specified above. All measurements should be made with a ME-25/U series, or a Navy Model OBQ series, or equivalent electronic voltmeter. Resistance measurements are made with the power connector disconnected and the receiver chassis out of its case.

Values of voltage and resistance as measured in the equipment should be within ±20 per cent of those given in the tables.

3. ELECTRON TUBE INFORMATION.

a. TUBE DATA.—The full complement of electron tubes used in Radio Receiver R-518/FRR-27 is given in table 1-4. These tubes are all located on either the RF, IF, or Audio/Power Supply chassis assemblies of the receiver. Their locations on these individual chassis are shown in figure 5-1.

Voltage and resistance measurements between each pin of each tube and ground or other significant points, are given in table 7-13.

The rated operating characteristics of each type of tube employed are listed in table 7-15. Physical dimensions and characteristics curves are not given as this information is readily available in standard commercial catalogs.

b. TUBE CHECKING.—Access to all tubes is obtained by unscrewing the four Simmons fasteners on the front panel (one-quarter turn counterclockwise), depressing the two side lock latches (see figures 3-2 and 5-2), and pulling the chassis out of its case.

If the receiver fails to operate, but the panel neon lamp remains lighted indicating the presence of B+ voltage, the cause may be attributable to tube failure. Since it will not be known which tube has failed, each tube in the receiver should be replaced with a tube known to be good (and of the same type) in the following order until the defective one is located: first those on the Audio/Power Supply chassis, next those on the IF chassis, and finally those on the RF chassis.

NOTE

All tubes of a given type supplied with the equipment shall be consumed prior to employment of tubes from general stock.

TABLE 7-1. TEST EQUIPMENT REQUIRED

Equipment	Range Required	Model
Signal Generator	3-23 Mc	Navy Model LP or AN/URM-25
Signal Generator	100 - 156 Mc	Navy Model LX or AN/URM-26
Vacuum Tube Voltmeter	0-300 V DC 0-250 V AC	Navy Model OBQ or ME-25/U
Audio Output Meter	0.1 Mw to 2 W	Model ME-49/U or 22195
Heterodyne Frequency Meter	3-40 Mc	Navy Model LM or LR

4. ALIGNMENT PROCEDURES.

a. EQUIPMENT REQUIRED.—As listed in table 7-1, the preceding test equipment, or equivalent, should be available for proper alignment of the RF and IF sections, and for making audio checks.

b. PREPARATION OF THE RECEIVER FOR ALIGNMENT.

(1) Remove the receiver from its case by turning the four Simmons fasteners on the front panel, one-quarter turn counterclockwise; pull chassis out as far as the case locks will permit; release these two side locks by depressing the latches on the side of the case and pull chassis out of the case. (See figures 3-2 and 5-2.)

(2) Check the voltage of the available AC power source; move switchable link on terminal board TB301 (see figure 2-12) to the tap most nearly corresponding with the measured line voltage.

(3) Connect test cable W601 between the receiver chassis receptacle J302, and the rear panel case receptacle J504 (see figure 7-2).

(4) Connect an audio load to the AUDIO receptacle J503, located on the rear panel of the cabinet. This load can be a speaker, an audio output meter, or a resistance of from 200 to 600 ohms impedance. (See Fig. 7-3.)

(5) Throw noise LIMITER switch S201, located on the IF chassis, to OFF. (See Fig. 7-3.)

(6) Turn SQUELCH threshold control R216, located on the IF chassis, open (fully counterclockwise). (See Fig. 7-3.)

(7) Plug a 600 ohm audio output meter into the headphone jack J404, located on the front panel. (See Fig. 7-3.)

(8) Turn PHONES level control R401, located on the front panel, to maximum (fully clockwise). (See Fig. 7-3.)

(9) Turn AF LEVEL control R301, located on the Audio/Power Supply chassis, to approximately 50 per cent of maximum clockwise rotation. (See Fig. 7-3.)

(10) Connect line from the AC power source to the AC POWER receptacle J502, located on the rear panel. Throw POWER switch S401, located on the front panel, to ON. (See Fig. 7-3.)

WARNING

WHEN THE RECEIVER HAS BEEN PREPARED FOR ALIGNMENT AND THE POWER SWITCH IS OFF, DANGEROUS VOLTAGES ARE STILL PRESENT AT THE FOLLOWING POINTS:

AC connector J502 and filter networks connections if the cover plate is removed (see figure 1-11).
Chassis connector J302 (see figure 1-4).
Power fuses F301 and F302 (see figure 1-5).
POWER switch S401 terminals (see figure 4-1).
Primary taps of the power transformer T301, and terminal board TB301 (see figure 1-5).
Terminal pins numbers 14 and 16 of connectors J301 and J403 (see figures 1-4 and 4-1).

c. RECEIVER SECTION ALIGNMENT ORDER.—The receiver sections are aligned in the following order:

(1) Align 3 Mc IF stages. (See figure 7-4.)
(2) Peak 20 Mc oscillator. (See figure 7-5.)
(3) Align 23 Mc IF stage. (See figure 7-6.)
(4) Peak channel determining oscillator (30.2 - 37.75 Mc). (See figure 7-7.)
(5) Align multiplier, RF stages. (See figure 7-8.)

Step (1) is performed at the factory and rarely requires further adjustment.

Steps (2) and (3) are also performed at the factory and seldom require further adjustment unless tubes or other parts of the circuit are replaced. Tube or parts replacement necessitate realignment.

Steps (4) and (5) must be performed each time the receiver is changed to a new channel frequency.

All adjustments are made to obtain the maximum output of power or voltage, as shown on the indicating meters.

NOTE

All IF transformers are aligned with the conventional insulated aligning screwdriver. The transformers require tuning from both the top and underside of the chassis. A nonmetallic screwdriver should be used if the regular tuning tool is not available. The tuning tool supplied with the receiver is mounted inside the Audio/Power Supply chassis.

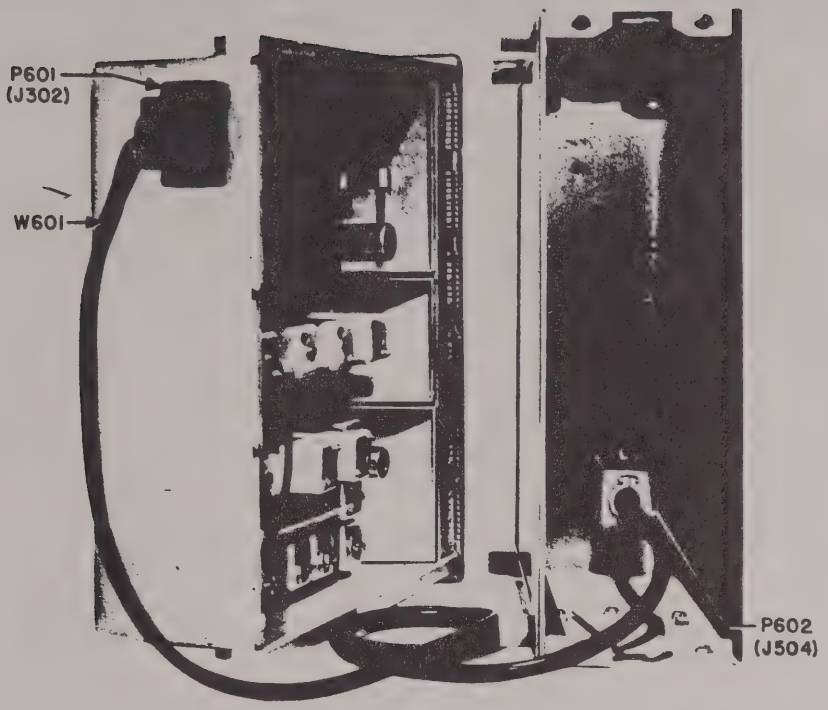


Figure 7-2. Receiver and Case, Connected by W601 Cable

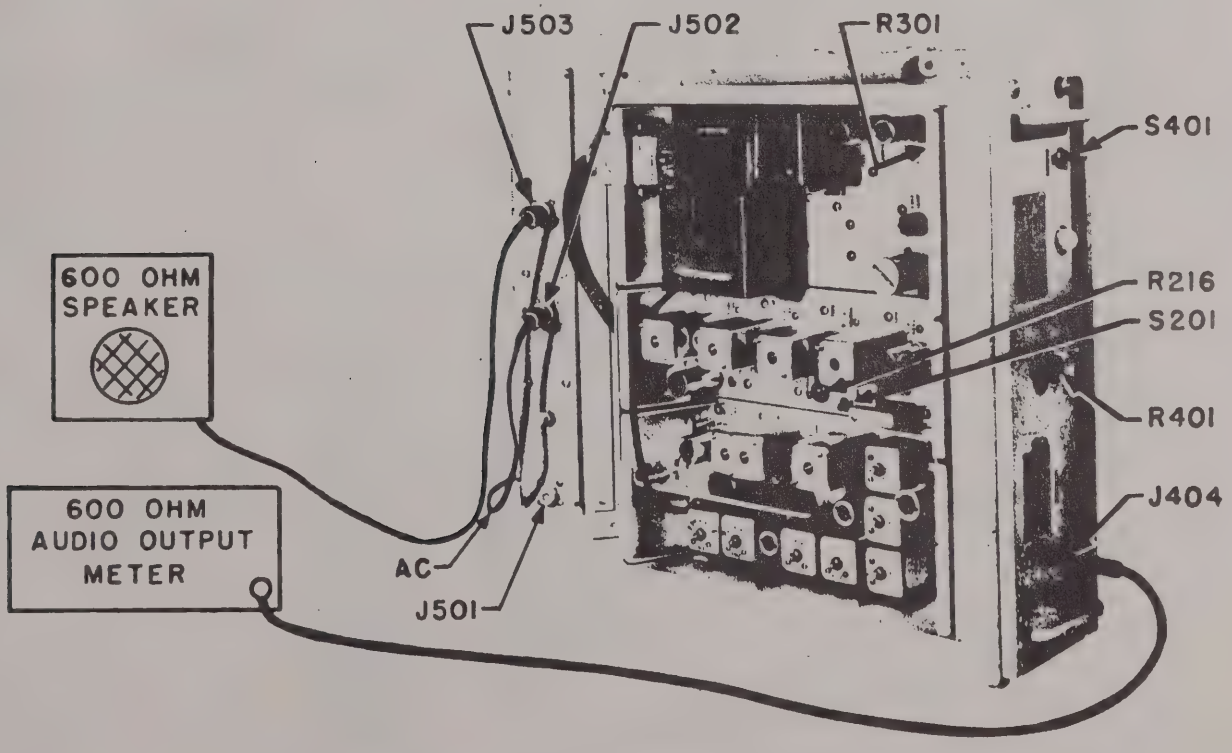


Figure 7-3. Preparation for Alignment, Top View and Rear Compartment

d. 3 MC IF AMPLIFIER ALIGNMENT.

(1) Prepare the 3 Mc signal generator for use by beating it into the frequency meter to obtain an accurate 3 Mc signal.

(2) Set up the receiver chassis and test equipment, as indicated in figure 7-4 for steps (1) to (8). Proceed with the alignment as outlined in table 7-2.

TABLE 7-2. 3 MC IF AMPLIFIER ALIGNMENT

STEP	TEST SIGNAL	TEST SIGNAL INJECTION POINT	METER	ALIGN	REMARKS
1	3 Mc; 30 per cent 1000 cps. modulation	Pin 1 (control grid) of V204 Third 3 Mc IF Amplifier	600 ohm audio output meter, connected to headphone jack	T204 (both slugs)	For sharpest peaks and greatest accuracy in alignment, keep the output of the signal generator low to avoid overloading the audio stages and to prevent AGC operation. This practice should be followed in the alignment of all stages.
2	Same as above	Pin 1 (control grid) of V203 Second 3 Mc IF Amplifier	Same as above	T203 (both slugs)	Same as above
3	Same as above	Pin 1 (control grid) of V202 First 3 Mc IF Amplifier	Same as above	T202 (both slugs)	Steps 1 through 4 constitute a rough tuning procedure
4	Same as above	IF Test Point Pin 1 (control grid) of V201 Second Mixer	Same as above	T201 (both slugs)	Steps 5 through 8 produce a more symmetrical frequency response of the IF amp
5	Same as above	Same as above	Same as above	T204	(a) Screw out top slug until limit is felt (DO NOT FORCE) (b) Peak bottom slug (c) Peak top slug
6	Same as above	Same as above	Same as above	T203	Same as above
7	Same as above	Same as above	Same as above	T202	Same as above
8	Same as above	Same as above	Same as above	T201	Same as above

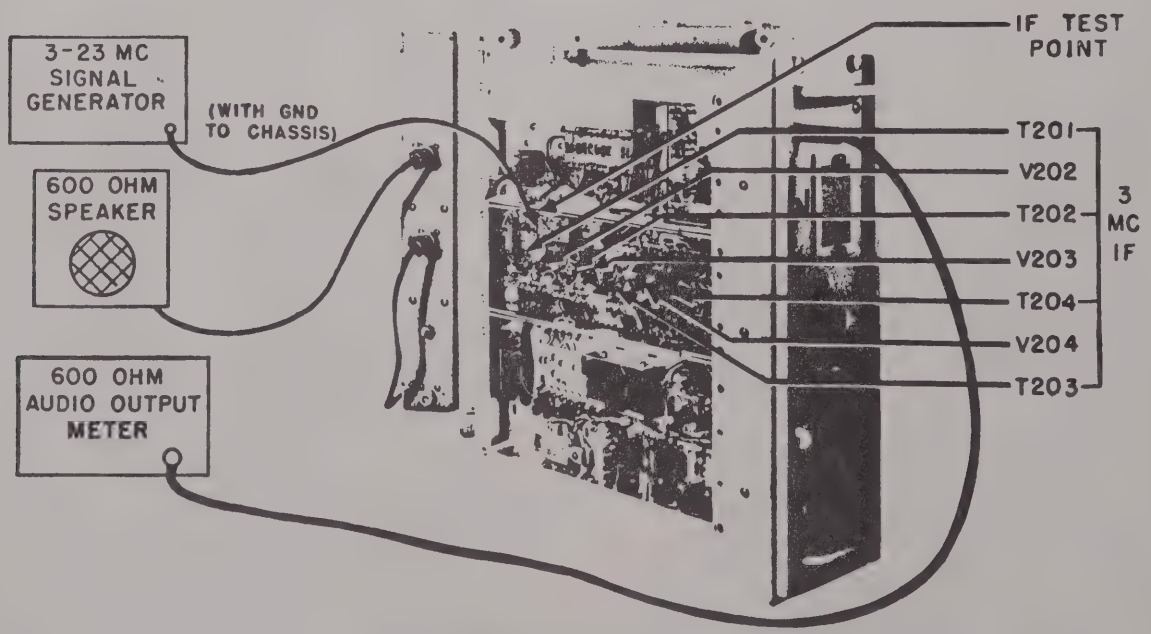


Figure 7-4. Alignment Set-up for 3 MC IF Section

e. 20 MC OSCILLATOR ALIGNMENT.

(1) Determine that the 20 Mc crystal Y101 is firmly seated in its socket.

(2) Connect the vacuum tube voltmeter, as indicated in figure 7-5, and proceed with alignment as outlined in table 7-3.

TABLE 7-3. 20 MC OSCILLATOR ALIGNMENT

STEP	TEST SIGNAL	TEST METER CONNECTION POINT	METER	ALIGN	REMARKS
1	None required (alignment is accomplished by tuning for maximum oscillator grid voltage)	Oscillator test point C140, located on top of RF chassis	Use 3 volt VTVM scale, switched to read negative voltage	Z108 top slug	Peak carefully; inaccurate tuning will cause the 20 Mc oscillator to be off frequency; meter reading should be approximately 0.76-1V negative

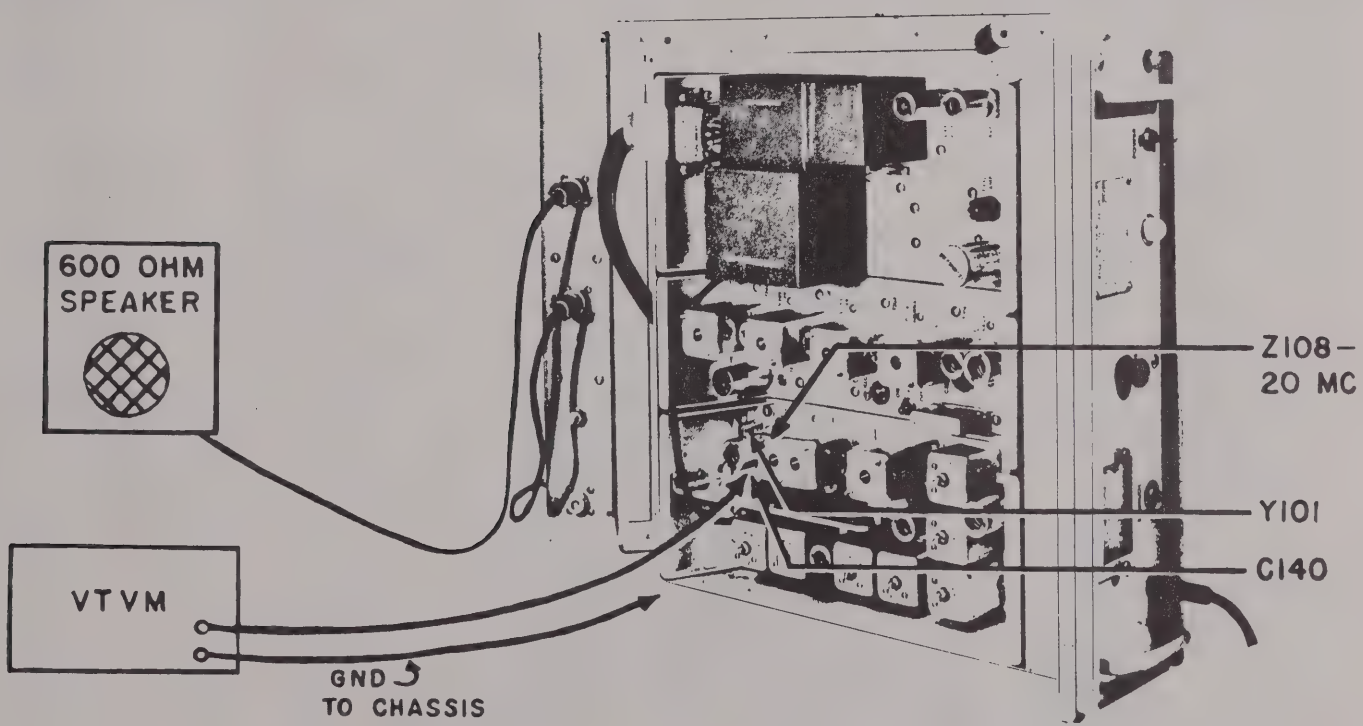


Figure 7-5. Alignment Set-up, 20 MC Oscillator

f. 23 MC IF AMPLIFIER ALIGNMENT.

(1) Connect the receiver, signal generator, and audio output meter as indicated in figure 7-6 and proceed with alignment, as outlined in table 7-4.

(2) In tuning, peaking should be done several times to obtain the most sensitive condition.

TABLE 7-4. 23 MC IF AMPLIFIER ALIGNMENT

STEP	TEST SIGNAL	TEST SIGNAL INJECTION POINT	METER	ALIGN	REMARKS
1	23 Mc; 30 per cent 1000 cps modulation	Pin 1 (control grid) of V103, 23 Mc IF amplifier	Use 600 ohm audio output meter plugged into headphone jack on front panel	Signal generator	Keep signal generator output low; it is not necessary to set the 23 Mc frequency accurately; instead, adjust the signal generator frequency carefully until maximum output meter reading is obtained
2	Same as above	Same as above	Same as above	T102 (both slugs)	Tune bottom slug, then top slug for maximum output
3	Same as above	Pin 1 (control grid) of V102, 1st Mixer	Same as above	T101 (both slugs)	Same as above

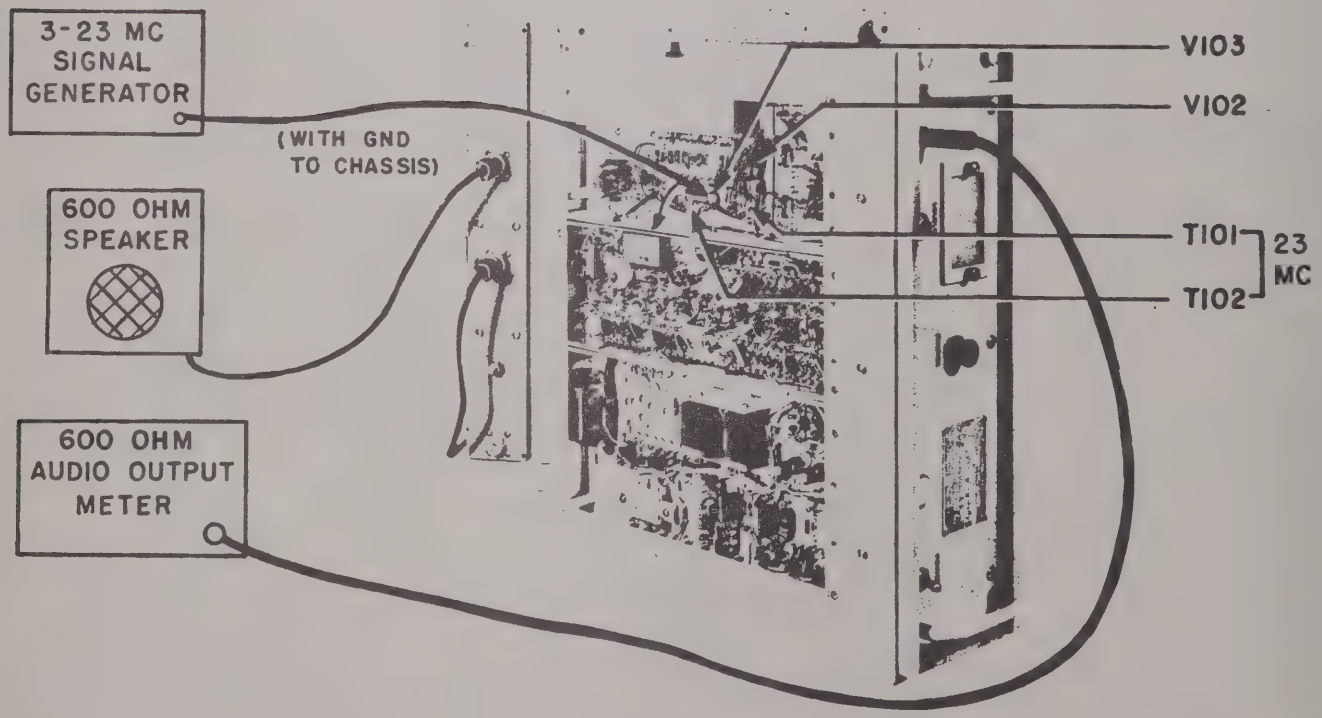


Figure 7-6. Alignment Set-up, 23Mc IF Amplifier

g. CRYSTAL Y102 FREQUENCY COMPUTATION.

CR-23/U crystals are used as Y102 in the channel determining oscillator-multiplier section. It is possible to use some crystals for two frequencies.

(1) In the range 100 to 128 Mc, use the formula:

$$\text{Crystal frequency in Mc} = \frac{\text{Channel Frequency in Mc} + 23\text{ Mc}}{4}$$

(2) In the range 128 to 156 Mc, use the formula:

$$\text{Crystal frequency in Mc} = \frac{\text{Channel Frequency in Mc} + 23\text{ Mc}}{5}$$

(3) Example: If the desired channel frequency is 118.3 Mc, use formula:

$$\text{Crystal frequency in Mc} = \frac{\text{Channel Frequency in Mc} + 23\text{ Mc}}{4}$$

$$\text{Crystal frequency} = \frac{\text{Channel Frequency (118.3)} + 23\text{ Mc}}{4}$$

$$= 35.325\text{ Mc}$$

h. CHANNEL DETERMINING OSCILLATOR ALIGNMENT.

(1) Insert the channel crystal Y102 in socket.

(2) Connect the receiver and vacuum tube voltmeter as indicated in figure 7-7 and proceed with alignment as outlined in table 7-5

TABLE 7-5. CHANNEL DETERMINING OSCILLATOR ALIGNMENT

STEP	TEST SIGNAL	TEST METER CONNECTION POINT	METER	ALIGN	REMARKS
1	None required (alignment is accomplished by tuning for maximum oscillator grid voltage)	Oscillator test point C132, located on top of RF chassis	Use VTVM switched to read negative voltage	C127 trimmer of Z107	Set C127 to the approximate frequency by the calibration on top of the shield can, then peak carefully. Inaccurate tuning will result in lowered receiver sensitivity. Meter should read approximately 8-11 V DC negative

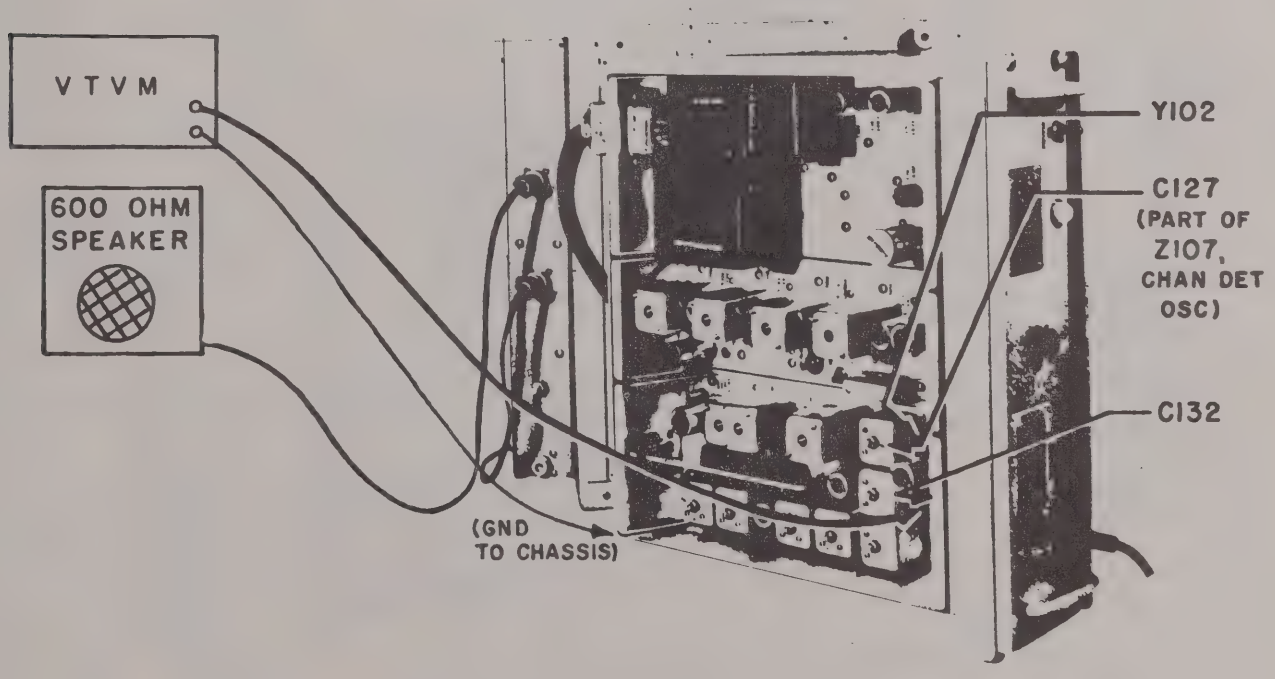


Figure 7-7. Channel Determining Oscillator Alignment

i. RF AND MULTIPLIER STAGES ALIGNMENT.

(1) Connect the receiver, high frequency signal generator, and audio output meter as indicated in figure 7-8 and proceed with alignment as outlined in table 7-6.

(2) Each time the channel frequency is changed, the RF and multiplier stages must be realigned, as outlined. When the receiver is placed into use and connected to its permanent antenna, a slight increase in sensitivity may be obtained by carefully readjusting transformer Z101, while receiving a weak signal.

TABLE 7-6. RF AND MULTIPLIER ALIGNMENT

STEP	TEST SIGNAL	TEST SIGNAL INJECTION POINT	METER	ALIGN	REMARKS
1	None	———	———	Z101, Z102 Z103, Z104 Z105, Z106	Rough tune to the desired frequency by the calibration on top of the transformer shield cans
2	Channel frequency	Antenna receptacle on RF chassis or 50 OHM ANTENNA receptacle on rear panel	Use 600 ohm audio output meter plugged into headphone jack on front panel	Signal generator to channel frequency	Roughly set the signal generator to the desired frequency. Use a strong signal and rock generator to obtain a maximum output. Reduce signal to the minimum readable for tuning.
3	Adjusted signal from step 2	Same as above	Same as above	Z106 *Z105 *Z104 *Z103 Z102 Z101 *NOTE: There is a slight pulling effect due to overcoupling	Carefully peak each transformer in the order listed, reducing the signal generator input signal to obtain maximum meter reading with minimum signal input. Repeat these adjustments until no improvement is obtained.

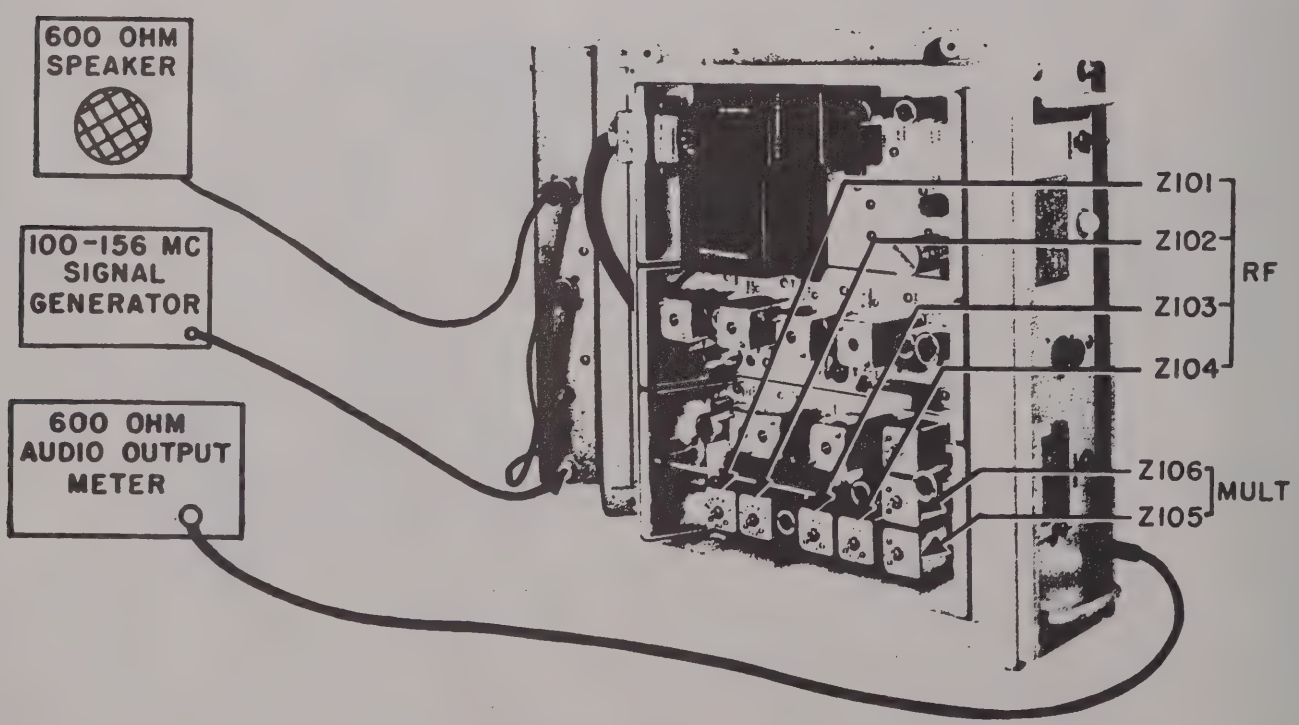


Figure 7-8. Alignment Set-up, RF and Multiplier

j. CONTROLS ADJUSTMENT.—After completion of the alignment, the chassis controls must be adjusted before the receiver is replaced in the cabinet. This procedure is described in SECTION 3, paragraph 4.

k. SQUELCH ADJUSTMENT.—The SQUELCH threshold control R216, located on the IF chassis assembly, may be adjusted to any degree of squelch desired, from a completely unsquelched condition, to a point where a signal of over 100 microvolts is required to open the squelch. In SECTION 3, paragraph 4 f, a simplified method of setting this control for its most sensitive point is described. Should circumstances require that the squelch open at some definite signal strength, a signal generator with its output accurately calibrated in microvolts is required, and the following procedure should be followed. (See figure 7-9.)

(1) Remove the receiver chassis from the case and connect these two units by means of the W601 test cable. (See figure 7-2.)

(2) Connect the signal generator (50 ohms output impedance) to the 50 ohm ANTENNA input on the rear panel, or the RF connector J101 on the RF chassis. Adjust the signal generator output to the desired signal strength. Throw the receiver POWER switch and the NOISE LIMITER switch ON and allow the set to warm up.

(3) Rotate the SQUELCH threshold control, from a fully clockwise setting toward the fully counterclockwise position, until the point is reached where the signal causes the squelch to open. Leave the control at this point. Remove the signal generator and reconnect the antenna.

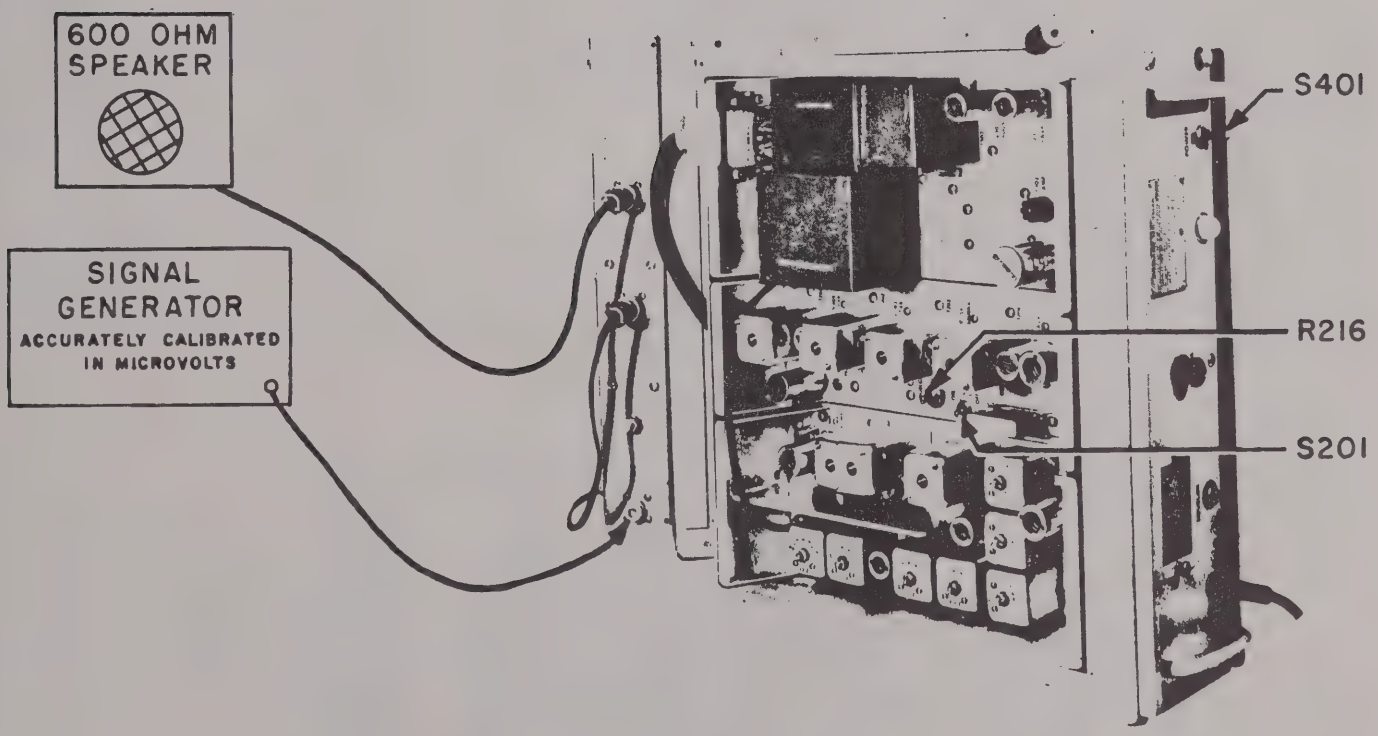


Figure 7-9. Squelch Adjustment Test Set-up

5. SUPPLEMENTARY TEST DATA.

The following tables, 7-7, 7-8 and 7-9, while not required for alignment, provide an accurate and reliable means of maintaining the receiver at peak performance, and offer a check against the correctness of receiver alignment. To make these tests, additional equipment is necessary such as a signal generator with an accurately calibrated output in microvolts, an audio oscillator with an output calibrated in millivolts and a 600 ohm impedance audio output meter with a range of 0.1 Mw to 2W.

Control settings and conditions of test are included with the tables.

a. AUDIO TEST DATA.

(1) Connect the 600 ohm audio output meter across pins A and B of audio receptacle J503, located on the rear panel. Proceed with the test as outlined in table 7-7. The test set-up is shown in figure 7-11. The overall audio response is indicated by figure 7-10.

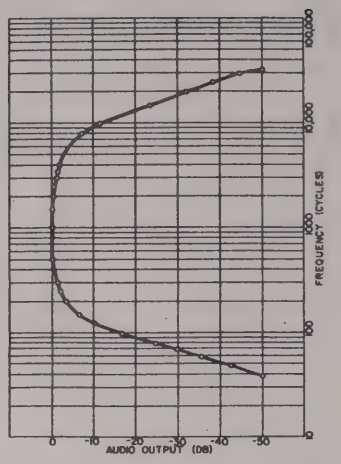


Figure 7-10. Audio Frequency Response

TABLE 7-7. AUDIO TEST DATA

Test Point	Test Input Voltage (Approximate)	Output Meter Reading 600 ohm load
V205, Pin 5	250 millivolts	10 db (60mw)
V206, Pin 7	12 millivolts	10 db (60mw)
V301, Pin 1	140 millivolts	10 db (60mw)
V302, Pin 1	0.9 volts	10 db (60mw)

Conditions of Test: AF LEVEL control at maximum (clockwise); NOISE LIMITER switch OFF. 4.5 volt battery connected plus to ground and minus to V205, Pin 1.

Input Signal: 1000 cycles audio through 0.1 μf or larger capacitor.

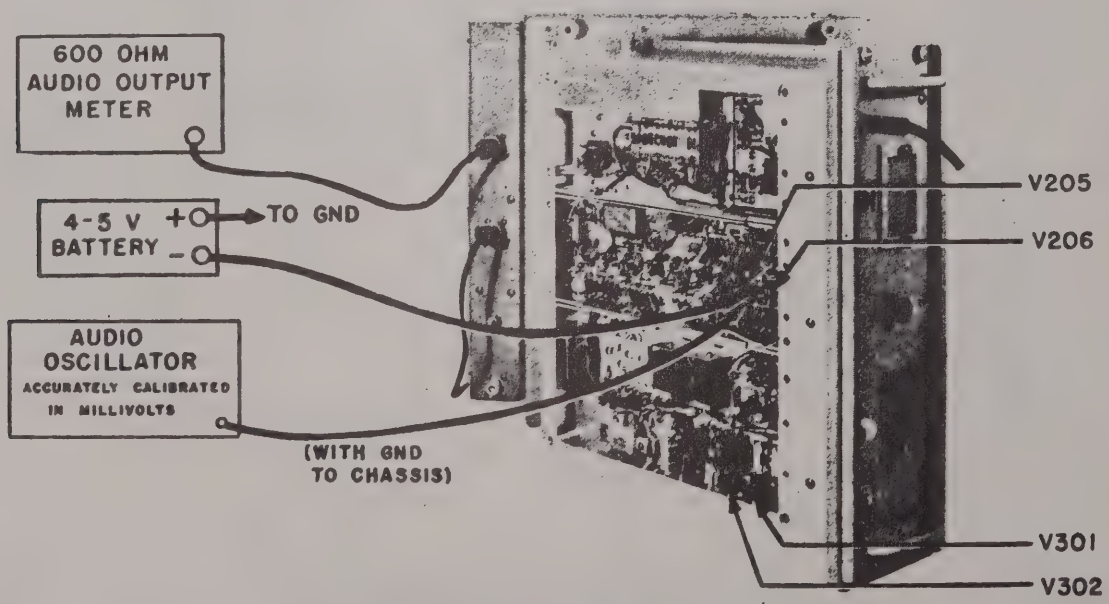


Figure 7-11. Audio Test Set-up

b. 3 MC INTERMEDIATE FREQUENCY DATA.

(1) Connect the 600 ohm audio output meter across pins A and B of audio output receptacle J503, located on the rear panel. Proceed with the test as outlined in table 7-8. The test set-up is shown in figure 7-12.

TABLE 7-8. 3 MC INTERMEDIATE FREQUENCY DATA

Test Point	Test Input Voltage (Approximate)	Output Meter Reading
V201 Pin 1 (or Test Point)	17 microvolts	10 db (60mw)
V202 Pin 1	68 microvolts	10 db (60mw)
V203 Pin 1	750 microvolts	10 db (60mw)
V204 Pin 1	2400 microvolts	10 db (60mw)
V205 Pin 5	3.4 volts	10 db (60mw)

Conditions of Test: Signal generator, accurately calibrated in microvolts; AF LEVEL control at maximum (clockwise); NOISE LIMITER switch OFF.

Input Signal: 3 Mc signal, 30 per cent modulated with 1000 cycles through a 0.01 μf capacitor.

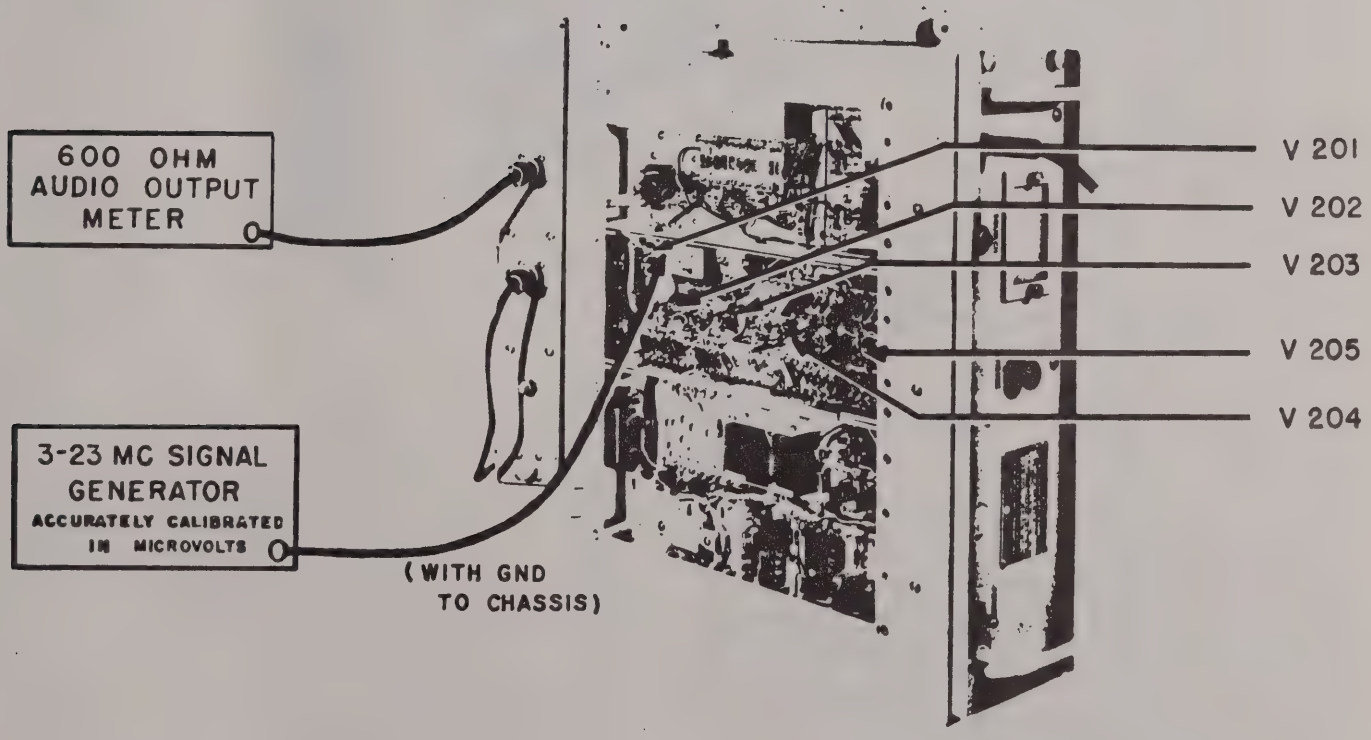


Figure 7-12. 3Mc Intermediate Frequency Test Set-up

c. 23 MC INTERMEDIATE FREQUENCY DATA.

(1) Connect the 600 ohm audio output meter across pins A and B of audio receptacle J503, located on the rear panel. Proceed with the test, as outlined in table 7-9. The test set-up is shown in figure 7-13.

TABLE 7-9. 23 MC INTERMEDIATE FREQUENCY DATA

Test Point	Test Input Voltage (Approximate)	Output Meter Reading
V102, Pin 1	64 microvolts	20 db (600mw)
V103, Pin 1	28 microvolts	20 db (600mw)

Conditions of Test: Signal generator, accurately calibrated in microvolts; AF LEVEL control at maximum (clockwise); NOISE LIMITER switch OFF.

Input Signal: 23 Mc signal, 30 percent modulated with 1000 cycles through a 0.01 μf capacitor.

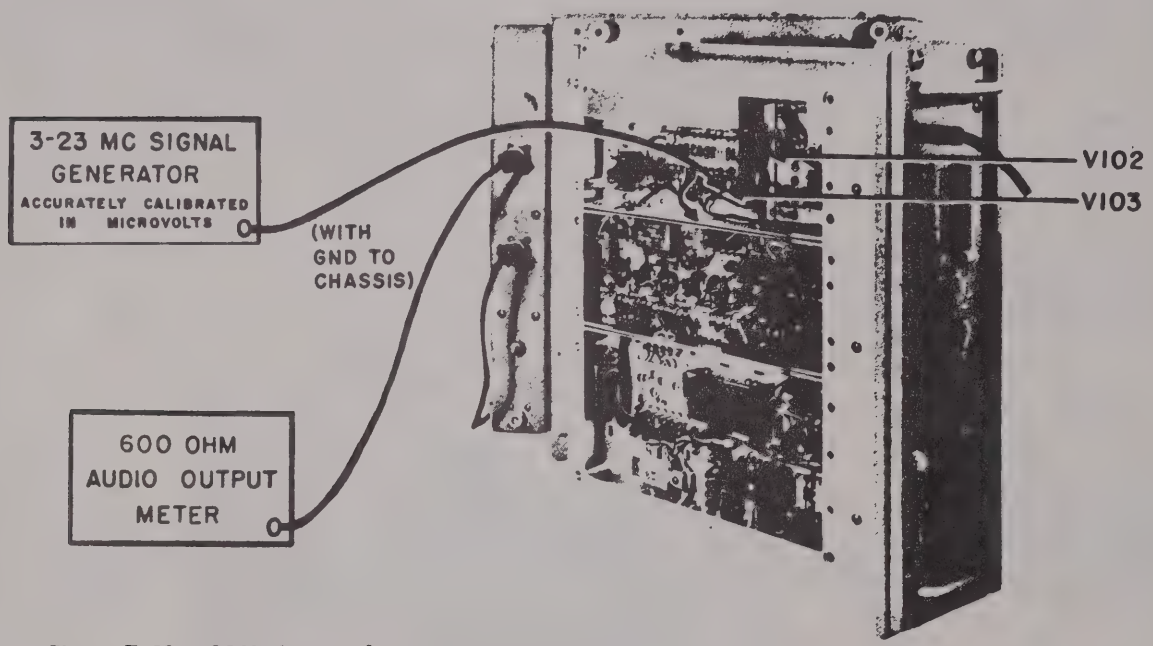


Figure 7-13. 23Mc Intermediate Frequency Test Set-up

d. OVER-ALL RECEIVER SENSITIVITY.

(1) This factor is indicated by the amount of RF signal required to obtain a 10 to 1, signal-to-noise ratio (modulated and unmodulated signal). In the AN/FRR-27, the over-all sensitivity should be between 2 and 8 microvolts for a 10 to 1 signal to noise ratio, throughout the entire tuning range of the receiver. The over-all IF selectivity characteristic is indicated by figure 7-14.

(2) Connect the 600 ohm audio output meter across pins A and B of audio receptacle J503, located on the rear panel. (See figure 7-15.) Proceed with the test, as outlined in table 7-10.

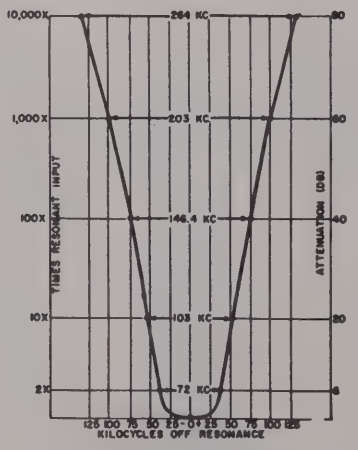


Figure 7-14. IF Selectivity Characteristic

TABLE 7-10. OVER-ALL RECEIVER SENSITIVITY

STEP	TEST SIGNAL	TEST SIGNAL INJECTION POINT	METER	PROCEDURE
1	100-156 Mc; 30 per cent 1000 cps Modulated	Antenna receptacle on RF chassis or 50 OHM ANT receptacle on rear panel.	600 ohm audio output meter	With modulation ON, observe and record the db reading on the output meter
2	100-156 Mc; unmodulated	Same as above	Same as above	When the modulation is switched OFF, the db reading will decrease. The amount of decrease desired is exactly 10 db, and is obtained by increasing or decreasing the signal generator RF output.
3	100-156 Mc; modulated or unmodulated	Same as above	Same as above	Adjust the RF signal, alternately cutting the modulation ON and OFF until an exact 10 db difference is obtained. The amount of RF signal required to obtain this difference should fall within the range of 2 to 8 microvolts.
4	Various frequencies throughout the receiver tuning range	Same as above	Same as above	Check this signal-to-noise ratio at various points throughout the receiver tuning range, repeating steps 1 through 3 at each frequency checked.

Conditions of Test: AF LEVEL control at 50 per cent rotation; NOISE LIMITER switch OFF.

Input Signal: As indicated in steps 1 through 4.

Signal Generator: The signal generator must be accurately calibrated in microvolts. The output must present a 50 ohm impedance to the receiver. If the generator's output is less than 50 ohms, a series resistor must be added to bring it up to the required impedance and the actual receiver input voltage calculated.

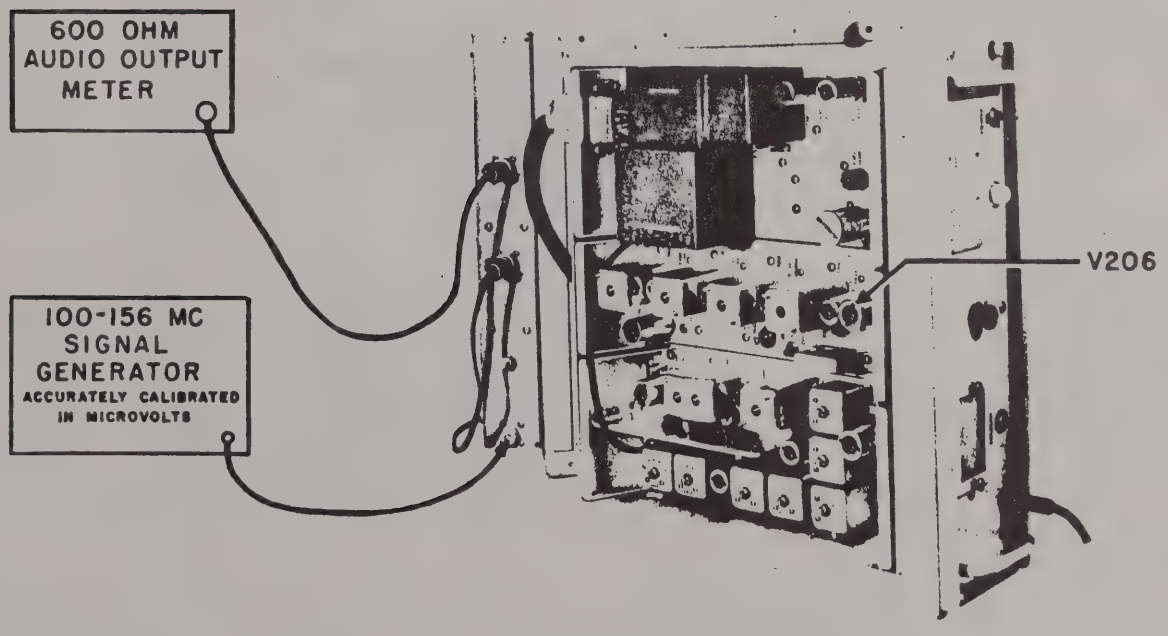


Figure 7-15. Equipment Set-up for Making Sensitivity Check

e. SIGNAL STRENGTH MEASUREMENTS.—Table 7-11, typical input readings for signal strength measurements provide additional means of checking the receiver for proper sensitivity. Bear in mind that the readings given in this table are only approximations, and may vary from one receiver to another due to variations in resistors, voltages, signal frequency, etc. A signal generator with an output accurately calibrated in microvolts, and a vacuum tube voltmeter are required to make these checks. (See figure 7-16.)

TABLE 7-11. TYPICAL INPUT READINGS—FOR SIGNAL STRENGTH MEASUREMENTS

INPUT (MICROVOLTS)	DETECTOR OUTPUT - VOLTS	AGC OUTPUT - VOLTS
1.0	— 1.1	—0.05
2	— 1.8	—0.05
5	— 4.1	—0.05
10	— 7.0	—0.13
20	—11.0	—0.25
100	—13.3	—0.85
1,000	—14.8	—1.75
10,000	—16.0	—2.5
100,000	—16.8	—3.2

Conditions of Test: Signal generator (50 ohm impedance) connected to the 50 OHM ANTENNA input on rear panel, or the RF receptacle J101 on the RF sub-chassis assembly; when checking Detector output, connect the vacuum tube voltmeter to the "DET" Metering and "DET GND" points, both on the IF sub-chassis assembly; when checking the AGC voltage, connect the vacuum tube voltmeter to the "AGC" Metering point and the ground pin; AF LEVEL Control, full counter-clockwise.

Input Signal: 120 Mc signal, 30 per cent modulated with 1000 cycles.

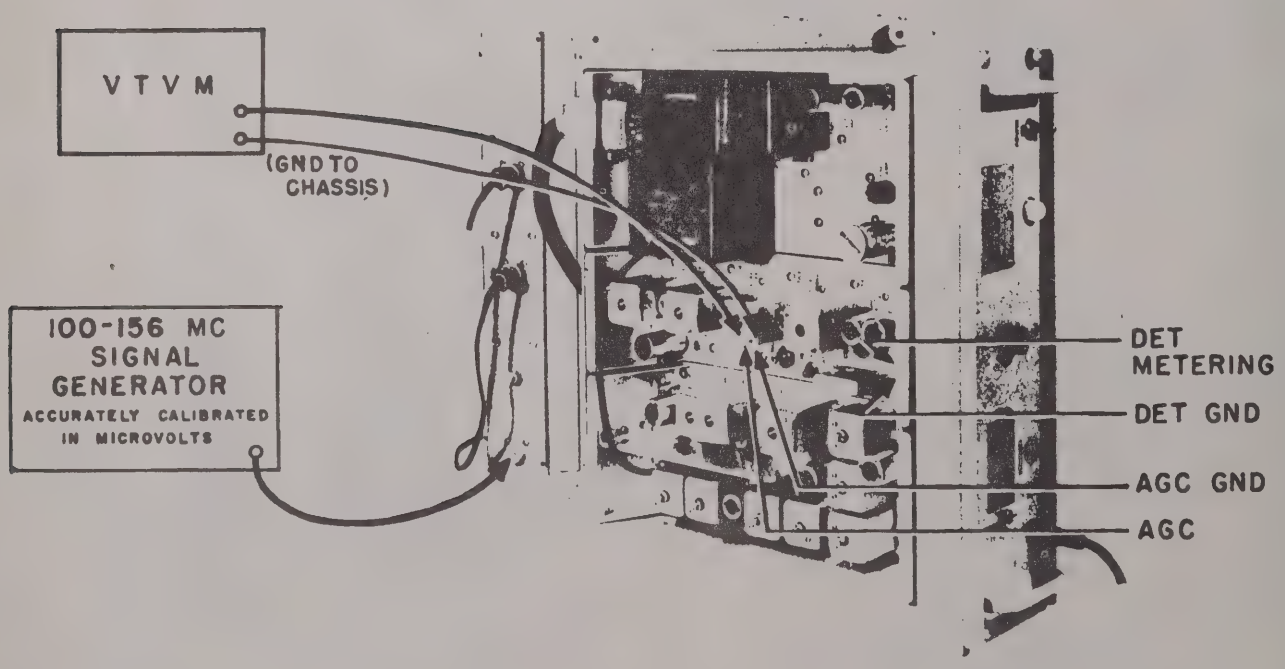


Figure 7-16. Equipment Set-up for Making Signal Strength Measurements

6. REMOVAL AND REPLACEMENT OF SUB-CHASSIS ASSEMBLIES.

The AN/FRR-27 Radio Receiving Set is designed to permit removal and replacement of complete functional units, without the necessity of unsoldering any connections. This type of plug-in assembly permits replacement of defective units by non-technical personnel, thereby reducing to a minimum the amount of time the equipment must be out of operation (see figure 3-5).

a. RF SUB-CHASSIS ASSEMBLY AR101. (Figures 1-4 and 2-2)

(1) This plug-in assembly, the left unit when viewed from the front (see figures 1-7 and 1-8) is held in place by its plug-in connector J102 (J401), and four Phillips head captive screws, one at each corner. To remove the unit, loosen the four captive screws and lift the sub-chassis assembly up by the use of the two angle brackets at each end. To replace, reverse this procedure.

(2) Unless a different channel frequency is desired, the RF/Multiplier stages, the Channel Determining Oscillator, 20 Mc Oscillator and the 23 Mc IF Amplifier may be aligned prior to installation in the receiver, provided the alignment is performed in another receiver of the same type with normal operating voltages. It should not require further alignment, even though the unit is changed from one AN/FRR-27 receiver to another. If a different channel frequency is desired, the RF and Channel Determining Oscillator/Multiplier stages must be realigned, in accordance with procedures of SECTION 7, paragraph 4g, 4h and 4i.

b. IF SUB-CHASSIS ASSEMBLY AR201 (See figures 1-4 and 2-7).

(1) This plug-in assembly, located in the center of the panel-frame assembly (see figures 1-7 and 1-9) is also held in place by its plug-in connector and four captive screws. Removal and replacement procedure is exactly as outlined in the previous paragraph for AR101.

(2) The 3 Mc IF Amplifier section of this unit may be aligned in any AN/FRR-27 receiver, according to the procedure outlined in SECTION 7, paragraph 4d. Thereafter, the aligned unit may be inter-changed in any AN/FRR-27 receiver without further adjustment of the IF section. Operating controls on this unit, such as the SQUELCH control (R216) and NOISE LIMITER switch (S201) must be readjusted when interchanged with other receivers, as outlined in SECTION 3, paragraph 4.

c. AUDIO/POWER SUPPLY SUB-CHASSIS ASSEMBLY AR301 (Figures 1-4 and 2-12).

(1) Mounting of this unit is the same as the previous two units, AR101 and AR201. Removal and replacement procedure is exactly as outlined for them.

(2) This unit requires no alignment and is therefore interchangeable in any AN/FRR-27 receiver. The A F LEVEL control (R301) must be adjusted after the unit is installed, in accordance with SECTION 3, paragraph 4. Also, the power transformer primary link of TB301 must be properly selected, as outlined in 4b (2).

d. FRONT PANEL-FRAME ASSEMBLY (Figure 1-7).—The front and rear panel with the sidepieces combine to form the framework into which the three plug-in assemblies are mounted. The panel mounts the POWER switch, the power indicator lamp, the SQUELCH test switch, the PHONES audio level control and the headphone jack. All of them are readily accessible for removal and replacement, as are the connector receptacles mounted on the shelf immediately back of the panel. Also on the two shelves are twelve threaded standoffs, into which the hold-down captive screws of the plug-in assemblies are screwed to hold the units in place.

e. REAR PANEL-COMPARTMENT (See figures 1-3 and 1-11).—This unit, referred to as a panel, is a permanently mounted compartment at the rear of the receiver case. It contains the AC and audio RF filters and provides receptacles into which the power, antenna and audio cables are plugged. Access to this compartment requires the loosening of three Phillips type screws, and lifting off the cover. The large receptacle J504 (J302) is mounted to face the inside of the case and engages the matching receptacle on the rear of the Audio/Power Supply sub-chassis when the receiver is inserted in its case. When any alignment, adjustment or other operation requires the removal of the receiver from its case, a test cable (W601) bridges the connections between the rear panel and the Audio/Power Supply sub-chassis.

7. REMOVAL AND REPLACEMENT OF PARTS.

Removal and replacement of most parts of Radio Receiver R 518/FRR-27 is a routine and simple procedure, involving only the removal of mounting screws or bolts and the unsoldering of connecting wires. A few parts, due to their location and/or construction require special precautions or directions for replacement, as described in the following paragraphs:

a. POWER TRANSFORMER T301 (See figures 1-4 and 2-12).—Power transformer T301, located on the Audio-Power Supply chassis is mounted by four 8-32 thread weldbolts and hex nuts. Between the terminals on the bottom of this transformer is mounted the power transformer primary tap terminal board TB301. It is not necessary to remove TB301 when replacing the power transformer. Unsolder the connecting wires to the ten numbered terminals being careful to keep the wires in their normal location for ease in replacement.

Remove the four 8-32 hex nuts and lock washers and drop the transformer. Reverse this procedure for replacement. Wires leading to the transformer terminals are color coded, as indicated by the receiver schematic of figure 7-21.

b. SELENIUM RECTIFIERS CR301 and CR302 (See figure 1-5 and 2-12).—These units are mounted in an U channel aluminum bracket. The bracket is secured to the chassis by two 6-32 machine screws, and it is not necessary to remove this bracket when replacing the seleniums. First unsolder the connections to the unit (s). Remove the sub-chassis and unscrew the two 6-32 screws holding the selenium stacks. Two access holes in the side of the chassis can be used for screwdriver entry. Use a wrench to hold the nuts. Pull out the screws through the access holes and lift out the selenium stack. When replacing a selenium rectifier, it is important that proper polarity be observed. The seleniums used in this unit have three terminals, but only the two end terminals are used. Bend the selenium terminals to avoid shorts between the two units.

c. AUDIO OUTPUT TRANSFORMER T302 (See figures 1-4 and 2-12).—This transformer is located on the right side of the Audio/Power Supply sub-chassis directly in front of the Filter Reactor (L301). Removal of this part involves removal of the sub-chassis from the case; the unsoldering of connections, taking care to keep the connecting wires in their approximate locations and in the same order; and removal of the four 6-32 hex nuts and lock washers which hold the unit to the chassis. When installing the new transformer, special precautions must be taken to avoid reversing the transformer winding connections. Observe that the terminals are numbered on the bottom of the transformer. Be sure that these numbers are matched when installing the new part.

8. CABLE ASSEMBLY DETAILS

a. RF CABLES.—Supplied with the receiver is one length of AN type RG-58 A/U coaxial cable with a type UG-88/U, bayonet-style 50 Ohm connector at one end; the other end of the cable is permanently connected to receptacle J302 on the Audio-Power Supply sub-chassis. A short length of AN type RG-58 A/U cable in the rear panel-compartment connects J505 receptacle with the J401 connector. Unless subject to physical abuse or abnormal conditions of operation, these cables should require no further attention. Also supplied with the receiver is connector P501, which is a type UG-21 B/U coaxial plug, for use with 50 ohm transmission line. To assist maintenance personnel in assembly of this plug and cable; and to aid in the assembly of the inter-unit RG 58 A/U cable and UG-88/U connector should replacement become necessary, refer to figures 3-3 and 3-4 for details of fabrication.

b. AUDIO/AC CABLE DETAILS.—Connectors for these cables are supplied with the receiver, as listed in table 3-2. Since fabrication is comparatively simple, no specific details are given. To assure that the proper connector terminals are used for the audio lines, consult the receiver schematic, figure 7-21.

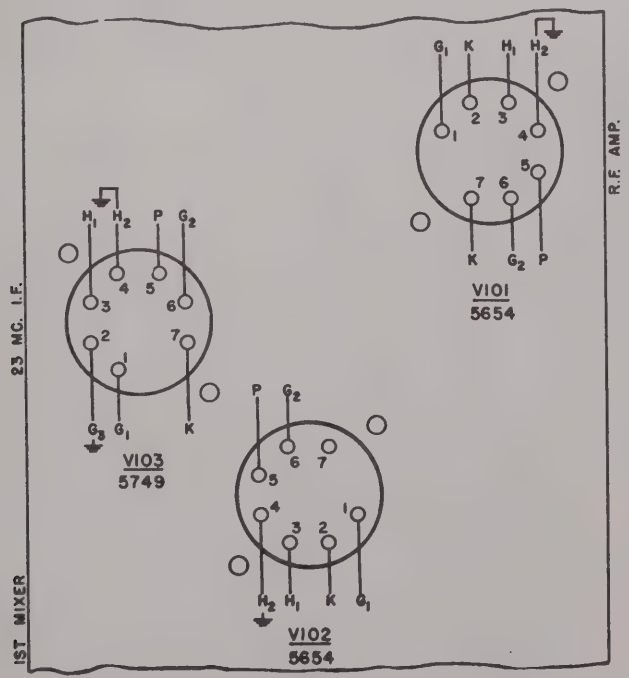


Figure 7-17. Tube Socket Diagram, RF Section, Bottom View

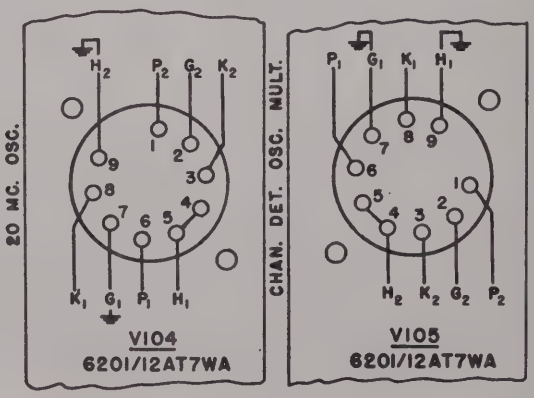


Figure 7-17A. Tube Socket Diagram Oscillator / Multiplier Section, Bottom View

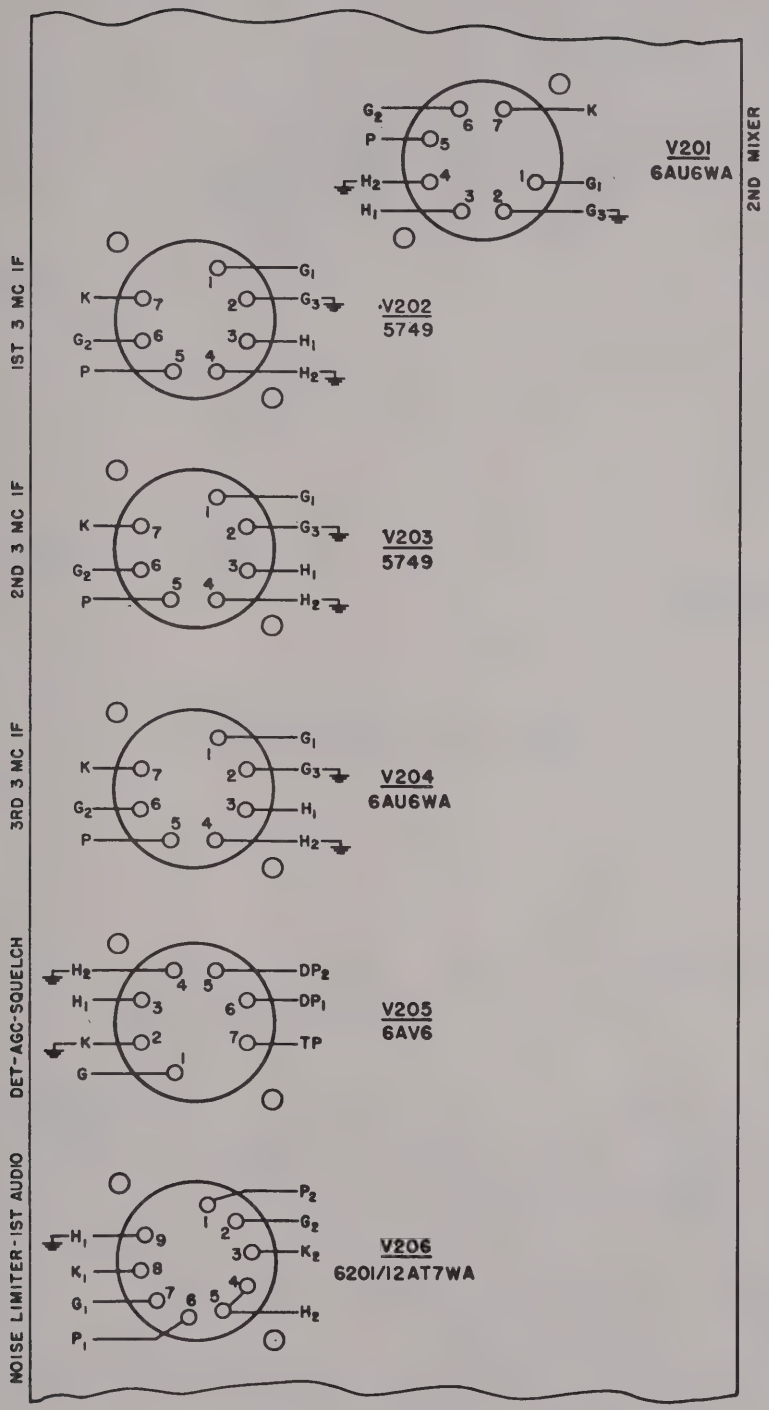


Figure 7-18. Tube Socket Diagram, IF Section Bottom View

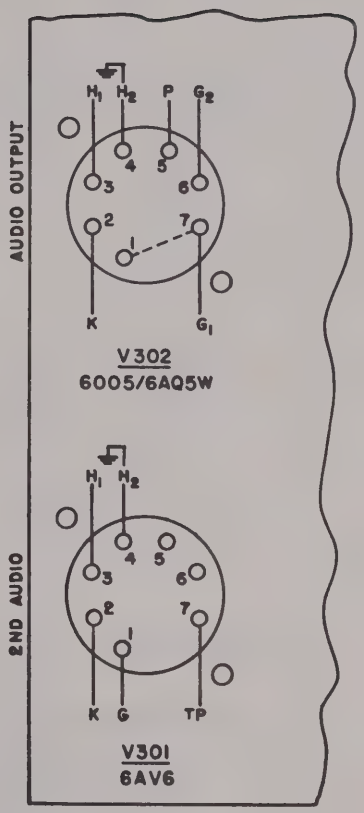
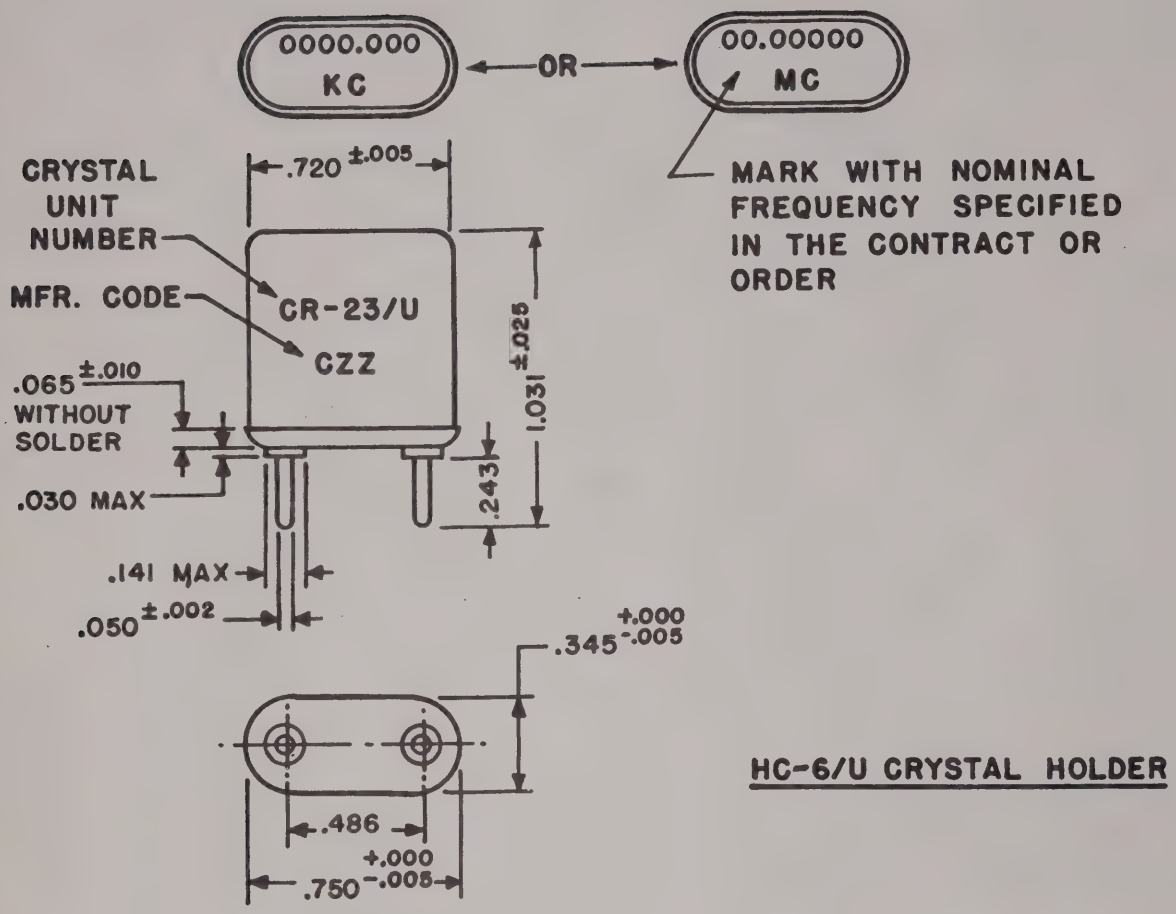


Figure 7-19. Tube Socket Diagram, Audio/Power Supply Section, Bottom View



1. FREQUENCY RANGE OF CRYSTAL CIRCUIT: Y101 – 20 MC
   Y102 – 30.2-37.75
2. INJECTION FREQUENCY:
   Y101: 20 MC
   Y102: 123-179 MC, OBTAINED IN THE CHANNEL DETERMINING OSCILLATOR MULTIPLIER STAGE, BY MULTIPLICATION OF 4 OR 5 TIMES DEPENDING ON CHANNEL USED
3. TEMPERATURE RANGE: -55°C TO +90°C, ±2°C
4. ACCURACY OF FREQUENCY OF CRYSTAL:
   ±0.005% OF NOMINAL FREQUENCY OVER ENTIRE TEMPERATURE RANGE GIVEN ABOVE
5. SEE COMPLETE SCHEMATIC FOR OSCILLATOR CIRCUITS WITH ELECTRICAL VALUES OF ALL ELEMENTS AND ALL VOLTAGES APPLIED TO OSCILLATOR TUBES

Figure 7-20. Outline and Data, Crystal Unit CR-23/U

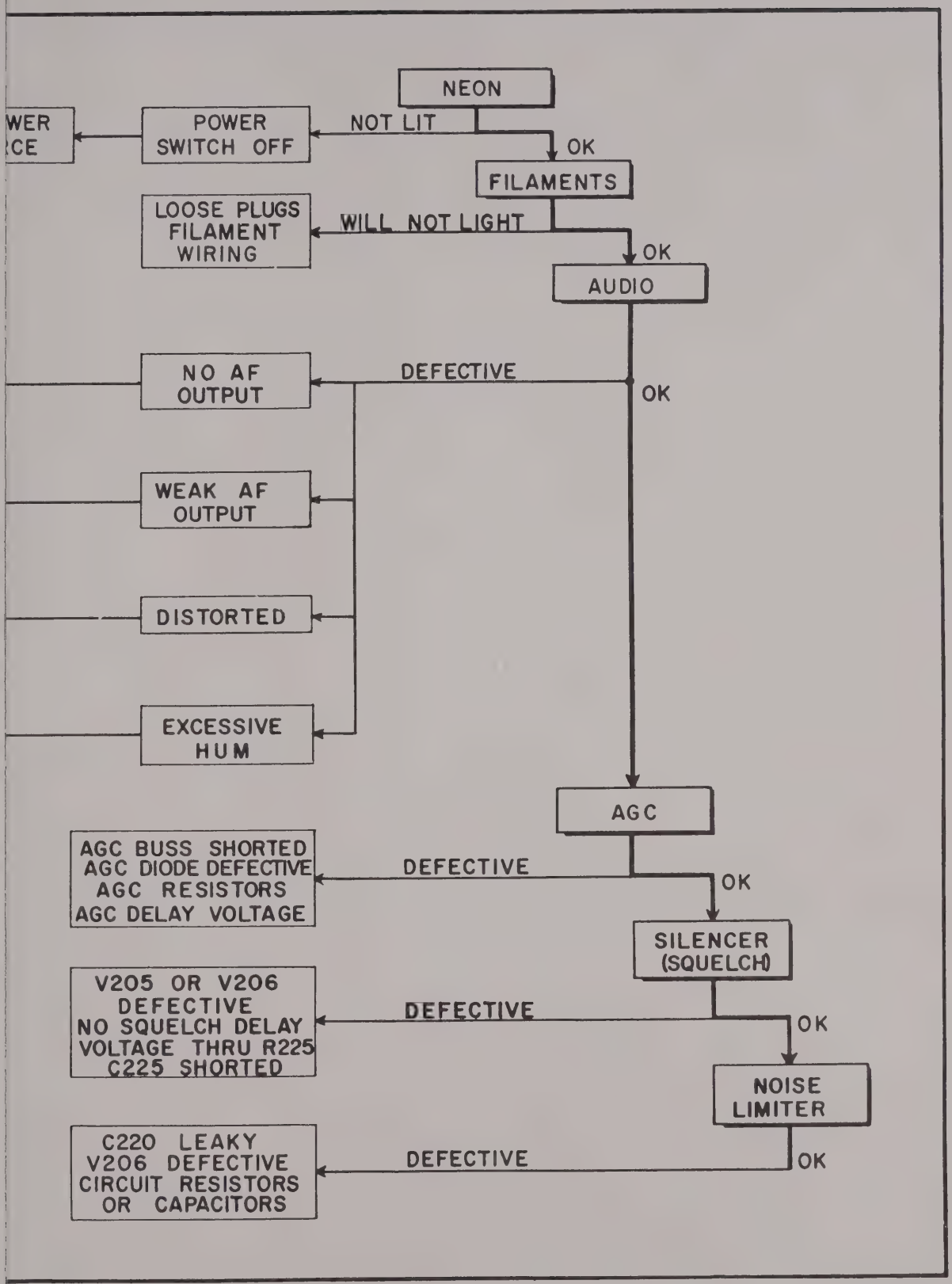
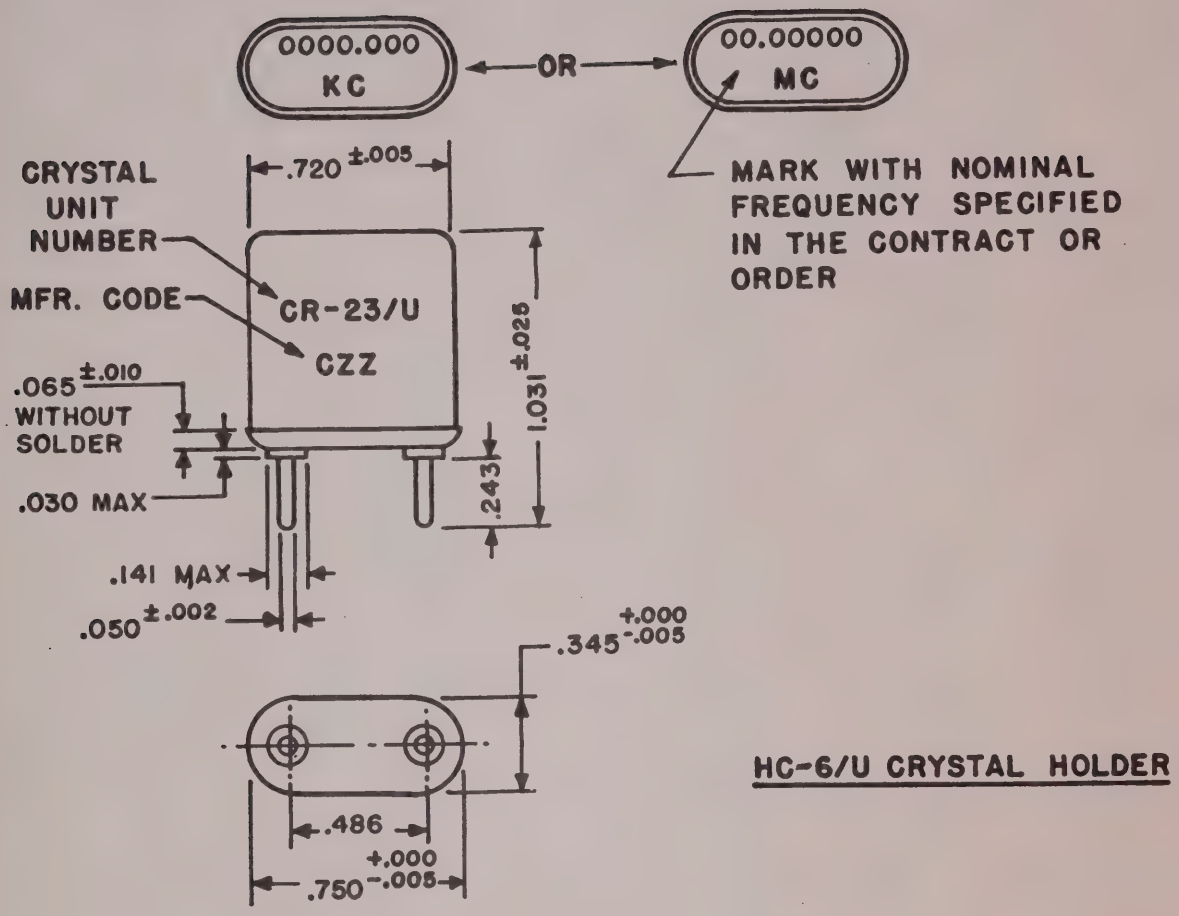


TABLE 7-12. TROUBLE SHOOTING CHART



1. FREQUENCY RANGE OF CRYSTAL CIRCUIT: Y101 – 20 MC
   Y102 – 30.2-37.75
2. INJECTION FREQUENCY:
   Y101: 20 MC
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3. TEMPERATURE RANGE: -55°C TO +90°C, ±2°C
4. ACCURACY OF FREQUENCY OF CRYSTAL:
   ±0.005% OF NOMINAL FREQUENCY OVER ENTIRE TEMPERATURE RANGE GIVEN ABOVE
5. SEE COMPLETE SCHEMATIC FOR OSCILLATOR CIRCUITS WITH ELECTRICAL VALUES OF ALL ELEMENTS AND ALL VOLTAGES APPLIED TO OSCILLATOR TUBES

Figure 7-20. Outline and Data, Crystal Unit CR-23/U

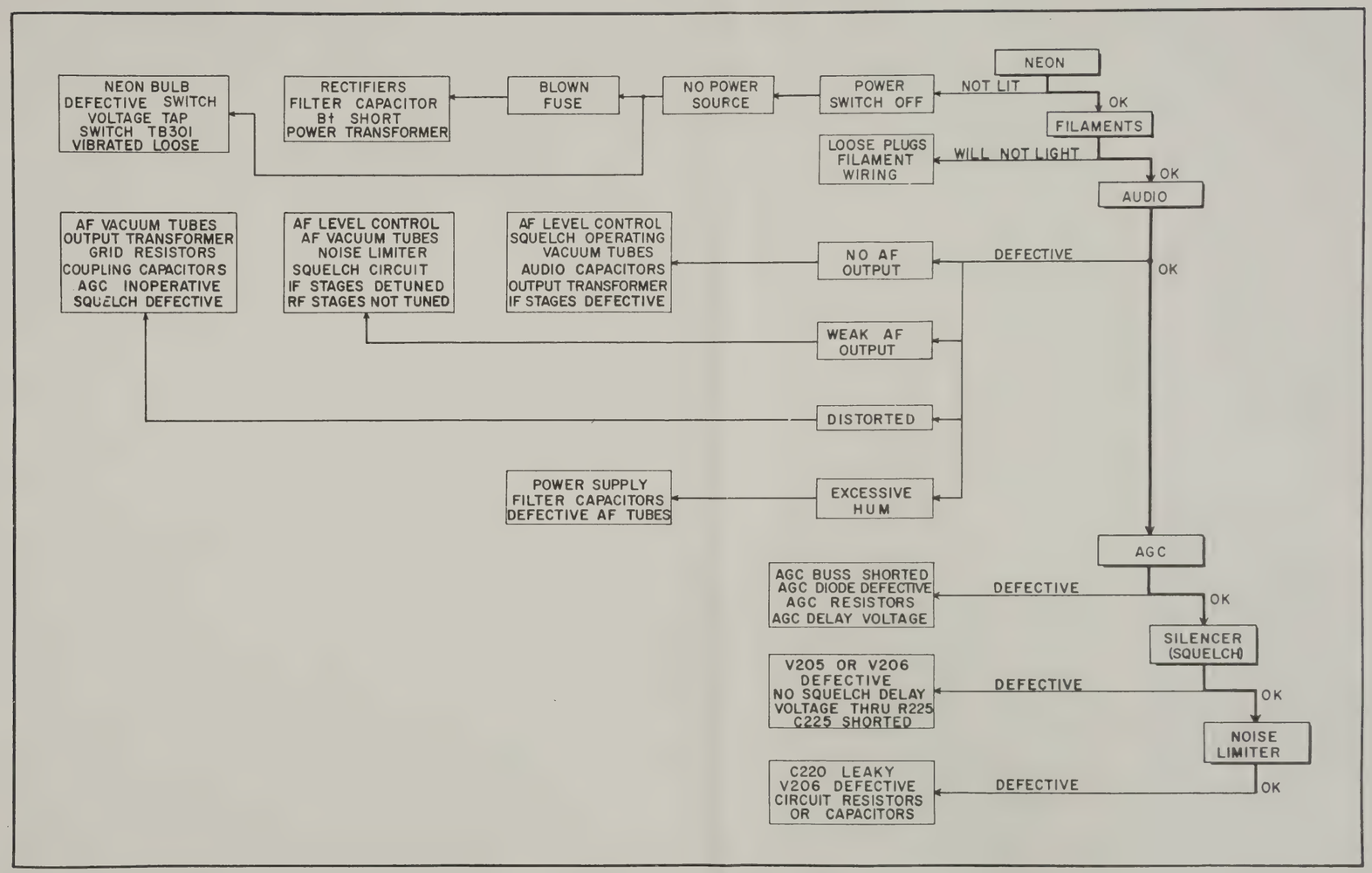

NEON
NOT LIT
OK
FILAMENTS
WILL NOT LIGHT
OK
AUDIO
POWER SWITCH OFF
NO POWER SOURCE
BLOWN FUSE
RECTIFIERS FILTER CAPACITOR B+ SHORT POWER TRANSFORMER
NEON BULB DEFECTIVE SWITCH VOLTAGE TAP SWITCH TB301 VIBRATED LOOSE
LOOSE PLUGS FILAMENT WIRING
NO AF OUTPUT
DEFECTIVE
OK
AF VACUUM TUBES OUTPUT TRANSFORMER GRID RESISTORS COUPLING CAPACITORS AGC INOPERATIVE SQUELCH DEFECTIVE
AF LEVEL CONTROL AF VACUUM TUBES NOISE LIMITER SQUELCH CIRCUIT IF STAGES DETUNED RF STAGES NOT TUNED
AF LEVEL CONTROL SQUELCH OPERATING VACUUM TUBES AUDIO CAPACITORS OUTPUT TRANSFORMER IF STAGES DEFECTIVE
WEAK AF OUTPUT
DISTORTED
EXCESSIVE HUM
POWER SUPPLY FILTER CAPACITORS DEFECTIVE AF TUBES
AGC
AGC BUSS SHORTED AGC DIODE DEFECTIVE AGC RESISTORS AGC DELAY VOLTAGE
DEFECTIVE
OK
SILENCER (SQUELCH)
V205 OR V206 DEFECTIVE NO SQUELCH DELAY VOLTAGE THRU R225 C225 SHORTED
DEFECTIVE
OK
NOISE LIMITER
C220 LEAKY V206 DEFECTIVE CIRCUIT RESISTORS OR CAPACITORS
DEFECTIVE
OK

TABLE 7-12. TROUBLE SHOOTING CHART

TABLE 7-13. VOLTAGE AND RESISTANCE MEASUREMENTS — FROM ELECTRON TUBE TERMINALS TO GROUND AND/OR OTHER SIGNIFICANT POINTS

SYMBOL AND JAN TYPE	ELEMENT	POINTS OF MEASUREMENT	POTENTIAL (VOLTS)	RESISTANCE (OHMS)
Radio Receiver R-518/FRR-27 — RF Chassis				
V101	Control Grid	Pin 1	—0.01	1.0 Meg
JAN-5654	Cath.-Supp. Grid	2	1.65	820
6AK5W	Heater	3	—	0
	Heater	4	—	0
	Plate	5	90	* 1 K
	Screen Grid	6	58	*19 K
	Cath.-Supp. Grid	7	1.65	820
V102	Control Grid	Pin 1	—0.05	470 K
JAN-5654	Cath.-Supp. Grid	2	3	4700
6AK5W	Heater	3	—	0
	Heater	4	—	0
	Plate	5	84	*10 K
	Screen Grid	6	84	*10 K
	Cath.-Supp. Grid	7	3	4700
V103	Control Grid	Pin 1	0	640 K
JAN-5749	Suppressor Grid	2	0	0
6BA6/W	Heater	3	—	0
	Heater	4	—	0
	Plate	5	36.0	*17 K
	Screen Grid	6	36.0	*17 K
	Cathode	7	1.2	470
V104	#2 Plate	Pin 1	72.0	*6800
JAN-6201	#2 Control Grid	(C 140 Test Point)	—0.7 to —1.2	22 K
12AT7WA	#2 Cathode	3	0.5	220
	Heater	4	—	0
	Heater	5	—	0
	#1 Plate	6	70.0	*6800
	#1 Control Grid	7	—	0
	#1 Cathode	8	0.82	470
	Heater C/T	9	—	—
V105	#2 Plate	Pin 1	98	* 1 K
JAN-6201	#2 Control Grid	(C 132 Test Point)	—7 to —11	22 K
12AT7WA	#2 Cathode	3	2.7	1000
	Heater	4	—	0
	Heater	5	—	0
	#1 Plate	6	98	*1 K
	#1 Control Grid	7	—	0
	#1 Cathode	8	0.86	220
	Heater C/T	9	—	0

Measurements to ground and voltage DC, unless otherwise indicated. Resistance measurements made with chassis in case. Conditions of measurement; line voltage 115 volts, 60 cps on 115 volt primary tap; AF LEVEL Control at maximum (clockwise); NOISE LIMITER Switch ON; SQUELCH Control open (maximum counter-clockwise) unless otherwise indicated in the chart. Resistance measurements made with AC power disconnected. All measurements taken with a vacuum tube voltmeter.
*Measured to + 115 Volt Buss.

TABLE 7-13. (Continued) VOLTAGE AND RESISTANCE MEASUREMENTS — FROM ELECTRON TUBE TERMINALS TO GROUND AND/OR OTHER SIGNIFICANT POINTS.

SYMBOL AND JAN TYPE	ELEMENTS	POINTS OF MEASUREMENT	POTENTIAL (VOLTS)	RESISTANCE (OHMS)
Radio Receiver R-518/FRR-27 — I-F Chassis				
V201 JAN-6AU6WA	Control Grid	Pin 1	0.0	100 K
	Suppressor Grid	2	—	0
	Heater	3	—	0
	Heater	4	—	0
	Plate	5	58	*47 K
	Screen Grid	6	58	*47 K
	Cathode	7	1.3	1500
V202 JAN-5749/ 6BA6W	Control Grid	Pin 1	0.0	640 K
	Suppressor Grid	2	—	0
	Heater	3	—	0
	Heater	4	—	0
	Plate	5	27	*10 K
	Screen Grid	6	27	*10 K
	Cathode	7	1.2	330
V203 JAN-5749/ 6BA6W	Control Grid	Pin 1	0.0	640 K
	Suppressor Grid	2	—	0
	Heater	3	—	0
	Heater	4	—	0
	Plate	5	83	*2200
	Screen Grid	6	83	*2200
	Cathode	7	1.8	220
V204 JAN-6AU6WA	Control Grid	Pin 1	0.0	2.2
	Suppressor Grid	2	—	0
	Heater	3	—	0
	Heater	4	—	0
	Plate	5	95	*1 K
	Screen Grid	6	95	*1 K
	Cathode	7	1.2	220

Measurements to ground and voltage DC, unless otherwise indicated. Resistance measurements made with chassis in case. Conditions of measurement; line voltage 115 volts, 60 cps on 115 volt primary tap; AF LEVEL Control at maximum (clockwise); NOISE LIMITER Switch ON; SQUELCH Control open (maximum counter-clockwise) unless otherwise indicated in the chart. Resistance measurements made with AC power disconnected. All measurements taken with a vacuum tube voltmeter.
*Measured to + 115 Volt Buss.

TABLE 7-13. (Continued) VOLTAGE AND RESISTANCE MEASUREMENTS — FROM ELECTRON TUBE TERMINALS TO GROUND AND/OR OTHER SIGNIFICANT POINTS.

SYMBOL AND JAN TYPE	ELEMENT	POINTS OF MEASUREMENT	POTENTIAL (VOLTS)	RESISTANCE (OHMS)
Radio Receiver R-518/FRR-27 — I-F Chassis (Continued)				
V205	Control Grid	Pin 1	—1.0	860 K
JAN-6AV6	Cathode	2	—	0
	Heater	3	—	0
	Heater	4	—	0
	#1 Diode Plate	5	—2.5	130 K
	#2 Diode Plate	6	0.0	540 K
	Plate	7	15	1 MEG
V206	#2 Plate	Pin 1	0.7	33 K
JAN-6201	#2 Control Grid	2	0.7	33 K
12AT7WA	#2 Cathode	3	0.14	2.6 MEG
	Heater	4	—	0
	Heater	5	—	0
	#1 Plate	6	50	150 K
	#1 Control Grid	7	15	1.6 MEG
	#1 Cathode	8	19	20 K
	Heater C/T	9	—	0

SYMBOL AND JAN TYPE	ELEMENT	POINTS OF MEASUREMENTS	POTENTIAL (VOLTS)	RESISTANCE (OHMS)
Radio Receiver R-518/FRR-27 — AF/Power Supply Chassis				
V301	Control Grid	Pin 1	—0.02	500 K
JAN-6AV6	Cathode	2	0.8	4700
	Heater	3	—	0
	Heater	4	—	0
	#1 Diode Plate	5	—	NC
	#2 Diode Plate	6	—	NC
	Plate	7	75	*200 K
V302	Control Grid	Pin 1	0.0	220 K
JAN-6005	Cathode	2	12.0	330
6AQ5W	Heater	3	—	0
	Heater	4	—	0
	Plate	5	220	*4180
	Screen Grid	6	230	*4000
	Control Grid	7	—	220 K

Measurements to ground and voltage DC, unless otherwise indicated. Resistance measurements made with chassis in case. Conditions of measurement; line voltage 115 volts, 60 cps on 115 volt primary tap; AF LEVEL Control at maximum (clockwise); NOISE LIMITER Switch ON; SQUELCH Control open (maximum counter-clockwise) unless otherwise indicated in the chart. Resistance measurements made with AC power disconnected. All measurements taken with a vacuum tube voltmeter.
*Measured to + 115 Volt Buss.

TABLE 7-14. TUBE OPERATING VOLTAGES AND CURRENTS

TUBE TYPE	FUNCTION	SYMBOL	HEATER AC (E)	CATHODE (E)	GRID (E)	SCREEN		SUPPRESSOR (E)	PLATE	
						(E)	(MA)		(E)	(MA)
JAN-5654 6AK5W	RF Amplifier	V101	6.3	[4]1.65	—0.01	58.0	0.2	[4]1.65	90.0	0.7
	First Mixer	V102	6.3	[4]3.0	—0.05	84.0	0.24	[4]3.0	84.0	0.6
JAN-5749 6BA6/W	23 Mc IF	V103	6.3	1.2	0.0	36.0	0.5	—	36.0	1.4
	First 3 Mc IF	V202	6.3	1.2	0.0	27.0	0.3	—	27.0	0.6
	Second 3 Mc IF	V203	6.3	1.8	0.0	83.0	2.2	—	83.0	5.6
JAN-6201 12AT7WA	20 Mc Oscillator	V104	6.3	[2]0.53 [1]0.82	[8]—0.7 to —1.2 [1]—	—	—	—	[2]70.0 [1]70.0	[2]2.17 [1]1.53
	Channel Determining Oscillator-Multiplier	V105	6.3	[2]2.7 [1]0.86	[2]—0.7 to —11 [1]—	—	—	—	[2]98.5 [1]98.0	[2]3.0 [1]4.15
	Noise Limiter-First Audio	V206	6.3	[2]+0.14 [1]19	[2]—0.7 [1] 15	—	—	—	[2] 0.7 [1]50.0	[2]0.001 [1]0.23
JAN-6AU6WA	Second Mixer	V201	6.3	1.3	0.0	58.0	0.37	—	58.0	0.5
	Third 3 Mc IF	V204	6.3	1.2	0.0	95.0	1.4	—	95.0	3.4
JAN-6AV6	Squelch-Detector-AGC	V205	6.3	—	—1.0	—	—	—	[3]15 [5]—2.5 [6]—0.05	0
	Second Audio Amplifier	V301	6.3	0.80	0.02	—	—	—	[3]75 [5]— [6]—	0.17
JAN-6005/ 6AQ5W	Audio Output	V302	6.3	12	0.0	230.0	2.5	—	220.0	40.

1. Triode Section 1.
2. Triode Section 2.
3. Triode Section.
4. Cathode and suppressor grid at same potential.
5. Diode number 2.
6. Diode number 1.
7. Measurements to ground and voltage dc, unless otherwise indicated. Conditions of measurement; line voltage 115 volts, 60 cps on 115 volt primary tap; AF LEVEL Control at maximum clockwise; NOISE LIMITER switch ON; SQUELCH Control open (maximum counter-clockwise) unless other wise indicated. All measurements made with a vacuum tube voltmeter.
8. C140 Test Point.

TABLE 7-15. RATED TUBE CHARACTERISTICS

Tube Type	Filament Voltage (V)	Filament Current (A)	Plate Voltage (V)	Grid Bias (V)	Screen Voltage (V)	Plate Current (MA)	Screen Current (MA)	AC Plate Resistance (Ohms)	Voltage Amplification Factor (MU)	Transconductance (Microhms)		Emission	
										Normal	Minimum	Is (MA)	Test Volt
JAN-5654 6AK5W	6.3	0.175	180	([1].)	120	7.7	2.4	0.69 Megohm	3500	5100	2900	([6].)	([6].)
JAN-5749 6BA6/W	6.3	0.3	250	([7].)	100	11.0	4.2	1.5 Megohms	6600	4400	4150	60	20
([2].) JAN-6201/ 12AT7WA	12.6 series 6.3 parallel	0.15 series 0.3 parallel	250	([8].)	Not Applicable	10.0	Not Applicable	10900	60	5500	4500	50	10
JAN-6AU6WA	6.3	0.3	250	—1.0	125	17.6	3.0	1.5 Megohms	36	4450	4150	60	20
JAN-6AV6	6.3	0.3	250	—2.0	Not Applicable	([3].) 1.2 ([4].) 1.0	Not Applicable	62500	100	1600	1250	([3].) 25 ([4].) 0.8	([3].) 30 ([4].) 10
JAN-6005/ 6AQ5W	6.3	0.45	250	—12.5	250	([9].) 45.0	([9].) 4.5	52000	200	4100	3000	100	30

([1].) Cathode bias resistor of 200 ohms, fixed bias operation not recommended.
([2].) Values are for each unit.
([3].) Triode section.
([4].) For each diode.
([5].) All values indicated are for typical operation and are not to be considered governing.
([6].) No values available.
([7].) Cathode bias resistor 68 ohms.
([8].) Cathode bias resistor 200 ohms.
([9].) Zero signal value.

TABLE 7-16. COIL WINDING DATA—ALL WIREWOUND PARTS, EXCEPT RESISTORS

Circuit Symbol	Drawing Number	Schematic Diagram	Coil Form	Winding	Wire and Size	No. of Turns and Location of Taps	D-C Resistance in OHMS	Inductance	"Q" and Frequency	Remarks
Radio Receiver R-518/FRR-27										
L113 L114 L401	327-R-E-306		Bakelite Pigtail Slug	Space Wound Solenoid	#34 Enameled	40 Turns	0.082	3 μh at 16.8 Mc	88 at 16.8 Mc	
L301	327-C-302		Iron	Choke	#30 Enameled	3000	150 Ohms ±15% at 25° C	10 H +50% —20% at 10 V 60 cycle, 0.1 amps DC	Not Applicable	Stancor Type 88 C 2
L501 L502 L505 L506	327-R-E-309		Wound on 3 Powdered Iron slugs Bolted together	3 Section Universal	#24 Double Nylon Covered	90 Turns Per Section	1.17	0.95 μh at 790 Kc	25 at 790 Kc	
L503 L504 L507 L508	327-R-E-308		Bakelite Pigtail Slug	Close Wound Solenoid	#24 Double Nylon Covered	24 Turns	0.065	0.5 μh at 25 Mc	Not Applicable	

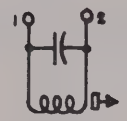
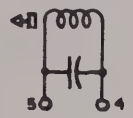
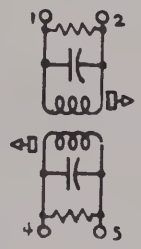
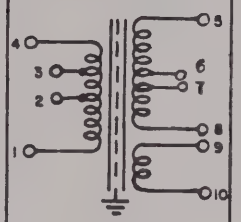
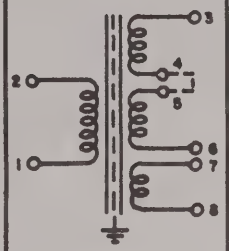
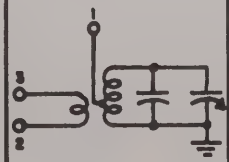
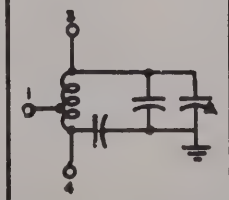
T101	327-R-E-320		Rolled Tubing PBE-T_r Adjustable Powdered Iron Slugs	Pri. L109 Space Wound Solenoid	#24 Double Nylon Covered	8	0.045	0.9 μh at 23Mc	144 at 23 Mc	56 $\mu\mu$f capacitor in shunt with Pri.
				Sec. L108 Space Wound Solenoid	#24 Double Nylon Covered	8	0.045	0.9 μh at 23Mc	144 at 23 Mc	47 $\mu\mu$f capacitor in shunt with Sec.
T102	327-R-E-323		Rolled Tubing PBE-T_r Adjustable Powdered Iron Slugs	Pri. L105 Space Wound Solenoid	#24 Double Nylon Covered	8	0.045	0.9 μh at 23Mc	144 at 23 Mc	47 $\mu\mu$f capacitors in shunt with Pri. and Sec. windings
				Sec. L106 Space Wound Solenoid	#24 Double Nylon Covered	8	0.045	0.9 μh at 23Mc	144 at 23 Mc	
T201 T202 T203 T204	327-R-E-321		Rolled Tubing PBE-T_r Adjustable Powdered Iron Slugs	Primaries; Universal L201 L203 L205 L207	10/44 Litz Single Silk Enameled	70	3.65	74 μh at 3Mc	40 at 3 Mc	33 $\mu\mu$f capacitors and 220K, ½W Loading Resistors, each in shunt with Primary and Secondary Windings
				Secondaries; Universal L202 L204 L206 L208	10/44 Litz Single Silk Enameled	70	3.65	74 μh at 3Mc	40 at 3 Mc	
T301	327-C-302		Core: .019" Dynamo Annealed; Stack: 1⅝"; Interleaved 3x3	Pri.	23 Enameled	370, Tap 310, 340	1-2 3.48 1-3 3.85 1-4 4.23	Voltages: #1-2 105V #1-3 115V #1-4 125V	Not Applicable	Stancor Type 88 P5 Electrostatic Shielding between windings #Input voltages *Output voltages
				Shield.	.001" Copper	1				
				Sec. #1	32 Enameled	1400 Taps 700 762	5-8 157 6-7 7	*5-6 225V *6-7 75V *6-8 225V		
				Sec. #2	15 Enameled	20	9-10 .058	*9-10 6.3V 5 Amps		

TABLE 7-16. (Continued) COIL WINDING DATA — ALL WIREWOUND PARTS, EXCEPT RESISTORS

Circuit Symbol	Drawing Number	Schematic Diagram	Coil Form	Winding	Wire and Size	No. of Turns and Location of Taps	D-C Resistance in OHMS	Inductance	"Q" and Frequency	Remarks
Radio Receiver R-518/FRR-27										
T302	327-C-301		Core: .019" Dynamo Annealed; Stack: ¾" Butt, air Gap .001	Pri. Shield Sec. #1 Sec. #2 Sec. #3	35 Enameled .001" Copper 30 Enameled 30 Enameled 30 Enameled	1700 1 210 210 60	1-2 180 3-6 17 7-8 2.5	Load Impedance 1-2 5000 Ohms 3-6 300 Ohms 7-8 600 Ohms	Not Applicable	Stancor Type 88 A10 Electrostatic Shielding between Windings
Z101	327-R-E-315		None	Pri. L101 327-R-E-311 Air Wound Loop Sec. L101 327-R-E-312 Air Wound Counter-Clockwise Solenoid	#18 AWG Hard Drawn Copper Tinned #18 AWG Hard Drawn Copper Tinned	1 3-2/3 Turns Tap at 2-2/3 Turns from Capacitor Statter End	0.01 or Less Approx. 0.01 or Less Approx.	 0.09 μh at 100 Mc Approx.	 250 at 100 Mc Approx.	3 μμf Fixed and 4-23 μμf variable capacitors each in Shunt with Secondary Winding
Z102	327-R-E-324		None	L102 327-R-E-312 Air Wound Counter-Clockwise Solenoid	#18 AWG Hard Drawn Copper Tinned	3-2/3 Turns, Tap 2-2/3 Turns from Capacitor Statter End	0.01 or Less Approx.	0.09 μh at 100 Mc Approx.	250 at 100 Mc Approx.	3 μμf Fixed and 4-23 μμf variable capacitors each in Shunt with Winding. 470 μμf Fixed Bypass capacitor.

Z103 Z104	327-R-E-316		None	L103 L104 327-R-E-312 Air Wound Counter- Clockwise Solenoid	#18 AWG Hard Drawn Copper Tinned	3-2/3 Turns, Tap at 2-2/3 Turns from Capacitor Statter End	0.01 or Less Approx.	0.09 μh at 100 Mc Approx.	250 at 100 Mc Approx.	4-23 μμf variable capacitor in Shunt with winding. 470 μμf Fixed By-pass capacitor.
Z105	327-R-E-317		None	L110 327-R-E-313 Air Wound Solenoid	#18 AWG Hard Drawn Copper Tinned	2 Turns, Tap at ½ Turn from Capacitor Statter End"	0.01 or Less Approx.	0.06 μh at 123 Mc Approx.	250 at 123 Mc Approx.	4-23 μμf variable capacitor in Shunt with Winding
Z106	327-R-E-318		None	L111 327-R-E-313 Air Wound Solenoid	#18 AWG Hard Drawn Copper Tinned	2 Turns, Tap at ½ Turn from Capacitor Statter End	0.01 or Less Approx.	0.06 μh at 123 Mc Approx.	250 at 123 Mc Approx.	4-23 μμf variable capacitor in Shunt with Winding. 470 μμf Fixed By-pass capacitor.
Z107	327-R-E-319		327-R-E-222 Glass Base Bakelite Tubing Type GSG	L112 327-R-E-314 Close Wound Solenoid	#22 AWG Copper Enameled	7½ Turns	0.02 or Less Approx.	0.79 μh at 31 Mc	105 at 31 Mc	4-23 μμf variable capacitor
Z108	327-R-E-322		Rolled Tubing PBE-Tr Adjustable Powdered Iron Slug	L107 Space Wound Solenoid	#24 Double Nylon	8	0.045	0.9 μh at 20 Mc	144 at 20 Mc	56 μμf Fixed capacitor in Shunt with Winding

NOTES

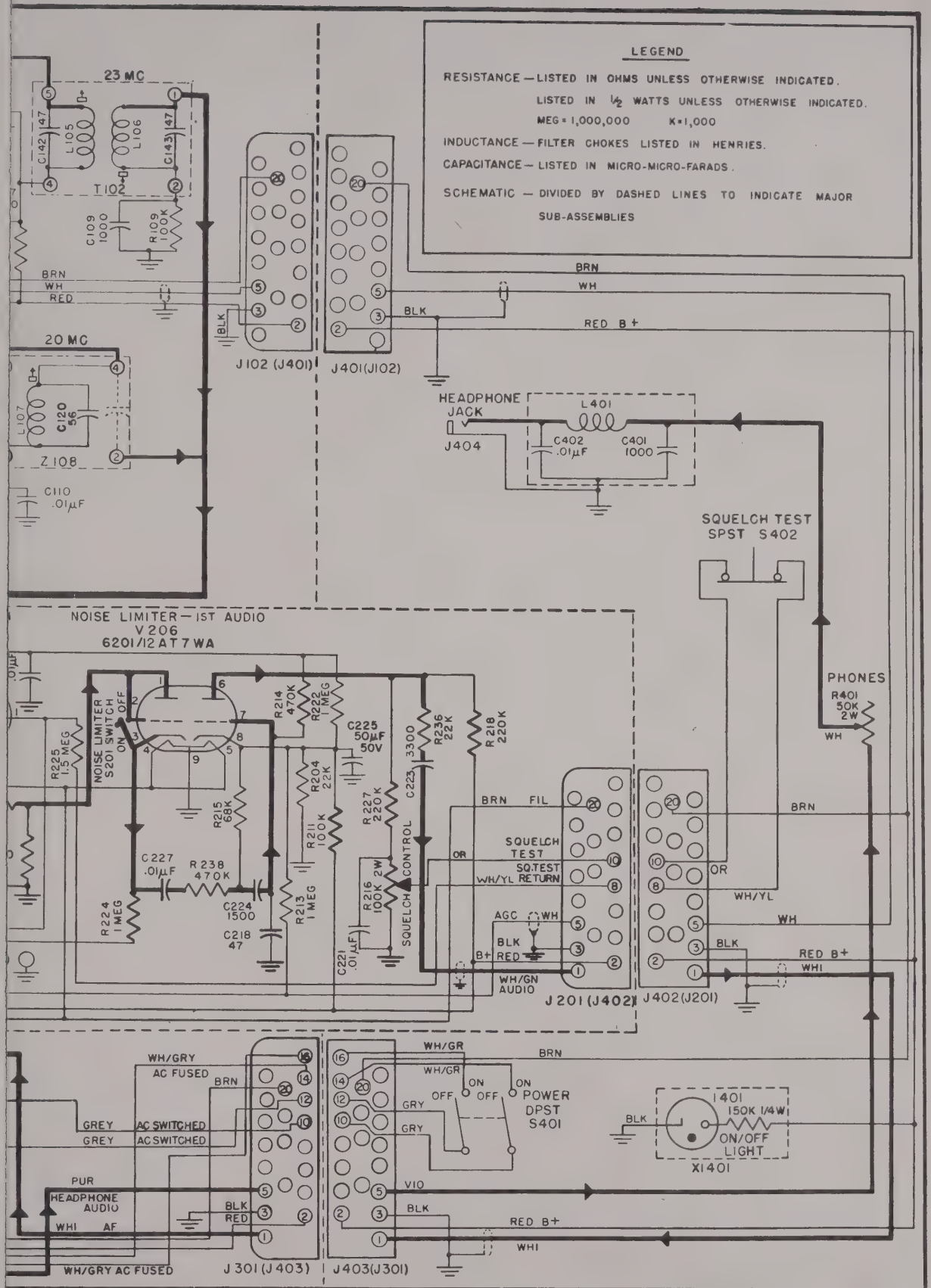


Figure 7-21. Schematic (Over-all), Radio Receiver R-518/FRR-27

NOTES

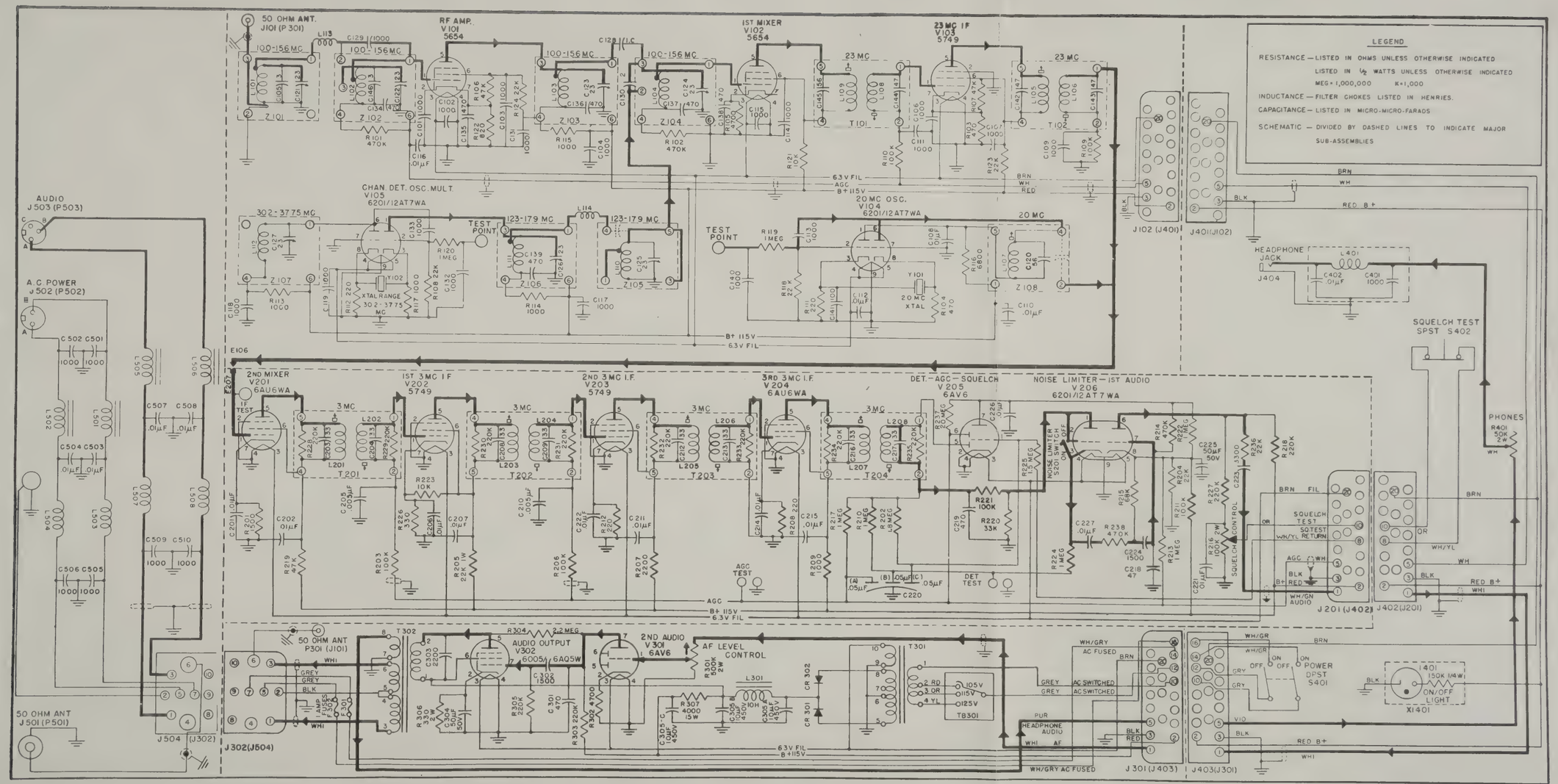


Figure 7-21. Schematic (Over-all), Radio Receiver R-518/FRR-27

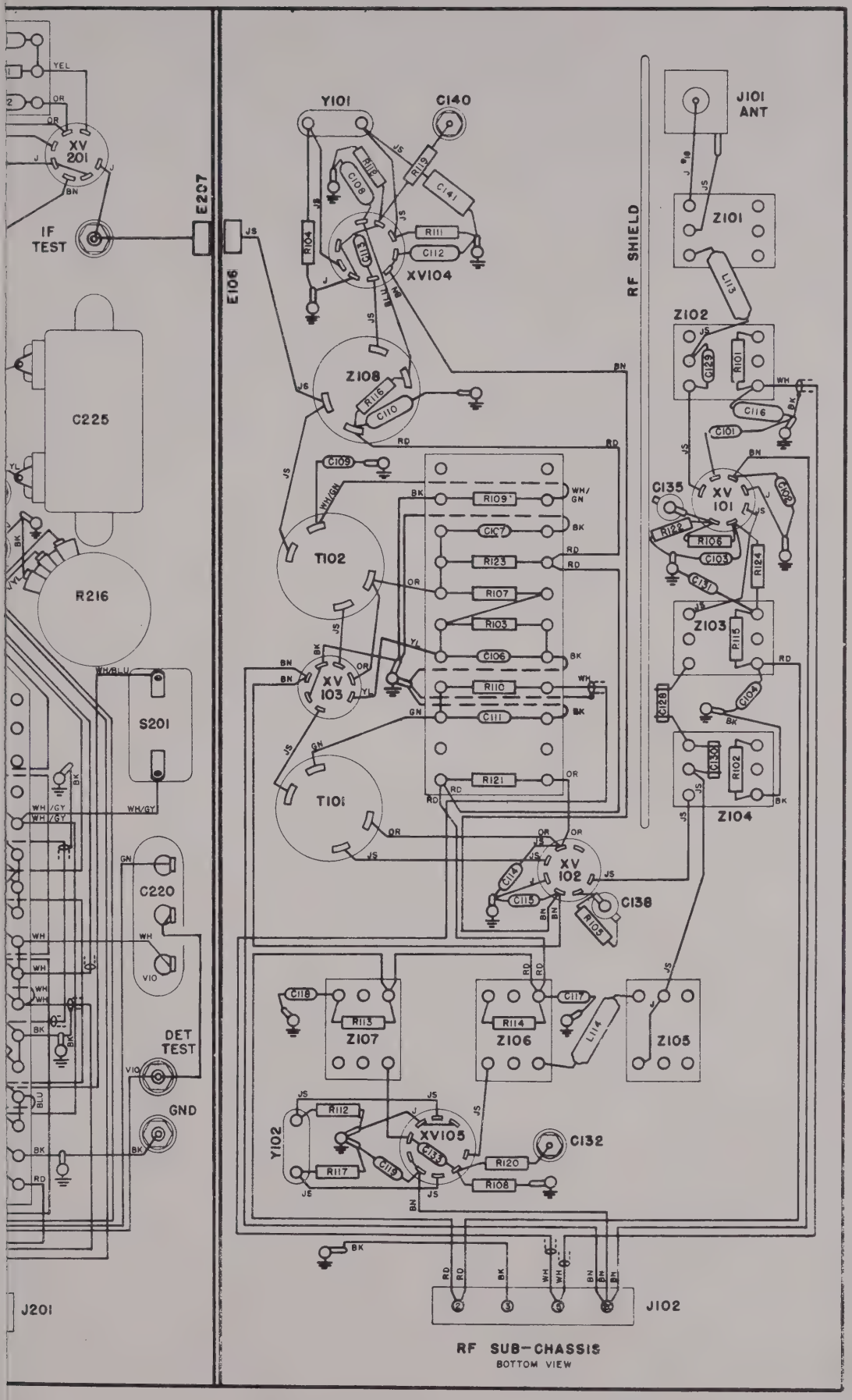


Figure 7-22. Wiring Diagram, Radio Receiver R-518/FRR-27 RF, IF Chassies

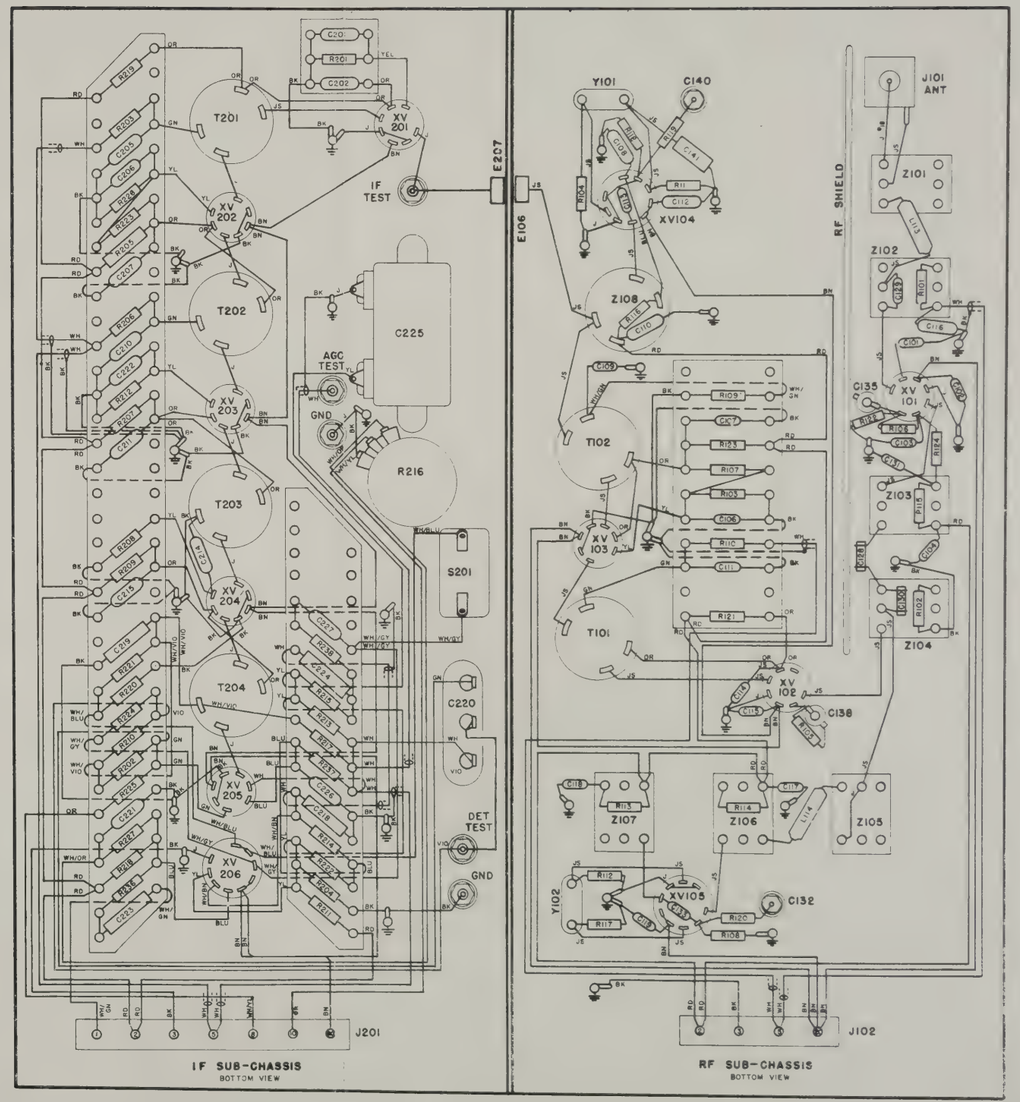


Figure 7-22. Wiring Diagram, Radio Receiver R-518/FRR-27 RF, IF Chassies

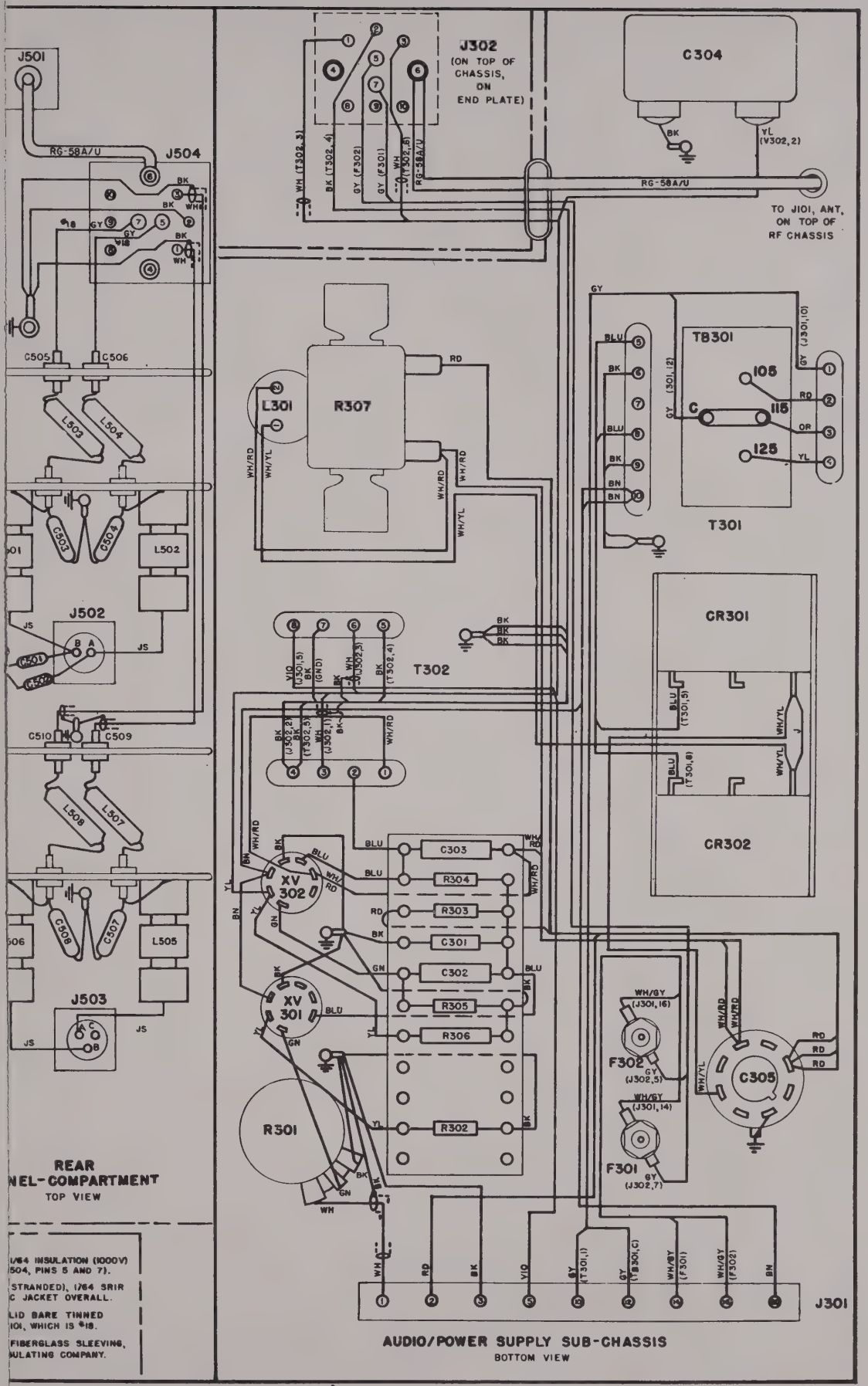


Figure 7-23. Wiring Diagram, Radio Receiver R-518/FRR-27 Audio Power Supply Chassis, Front Panel, Rear Compartment

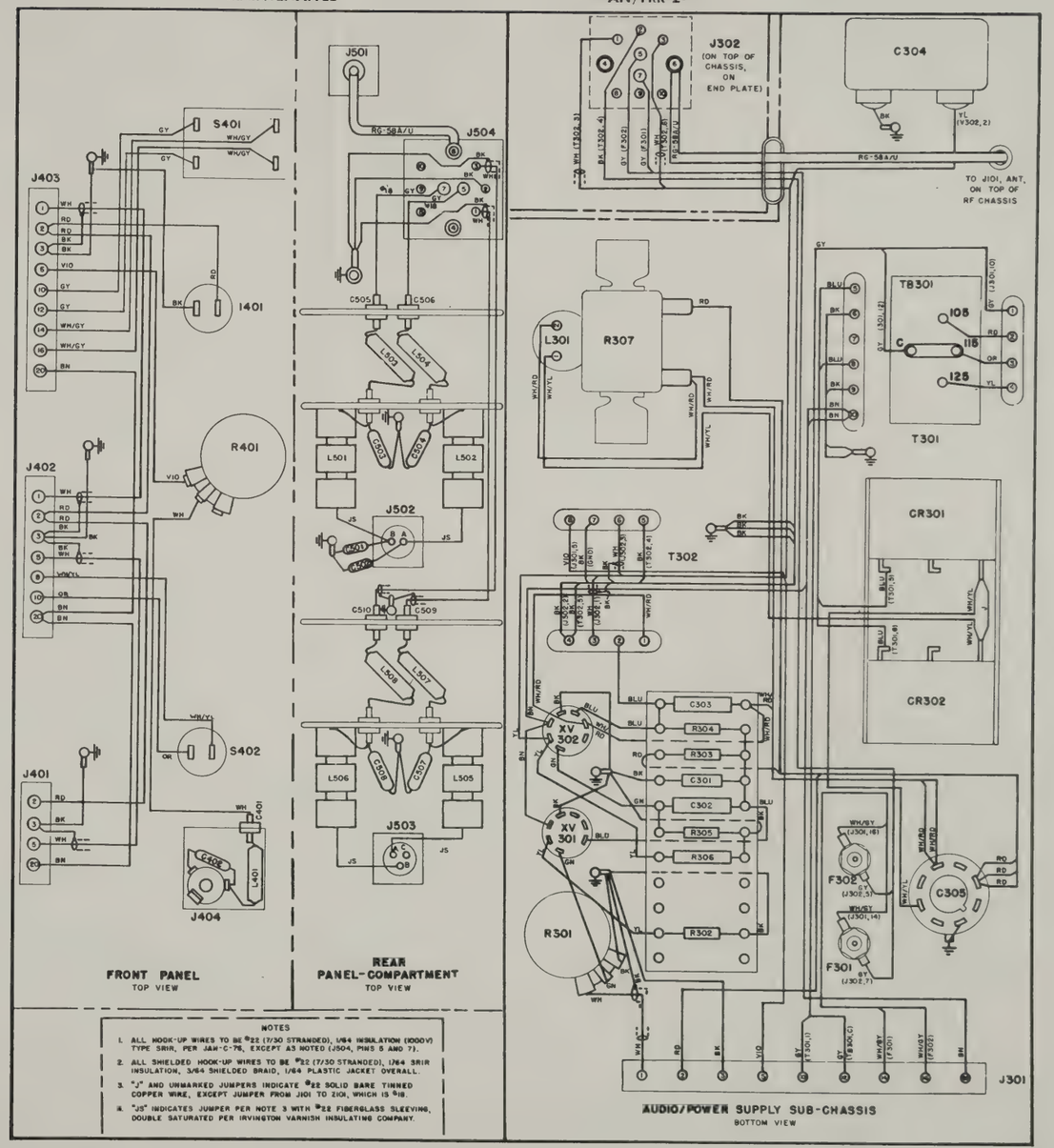


Figure 7-23. Wiring Diagram, Radio Receiver R-518/FRR-27 Audio Power Supply Chassis, Front Panel, Rear Compartment

SECTION 8
PARTS LIST AND MISCELLANEOUS TABLES

TABLE 8-1. LIST OF MAJOR UNITS

SYMBOL GROUP	QUANTITY	NAME OF MAJOR UNIT	DESIGNATION
101-699	1	Radio Receiving Set including one radio receiver	AN/FRR-27 R-518/FRR-27

TABLE 8-2. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NUMBERS STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS
AR101	N16-A-39380-1010	AMPLIFIER-OSCILLATOR: plug-in assembly; includes RF amplifier (100-156 Mc), Channel Determining Crystal Oscillator (30.2-37.75 Mc) 20 Mc Crystal Oscillator and 23 Mc IF Amplifier; voltage requirements: 6.3 v AC, 115 v DC; over-all max dim. 12 7/8" lg x 5" wide x 4 9/16" high; mounting: plugs into front frame mounted receptacle connector; held in place by four 10-32 Phillips truss head captive machine screws (2 in front and 2 at rear) which thread into frame mounted clinch standoffs; aluminum chassis; major components identified by symbol numbers, silk screened on chassis, top and bottom; RF, Multiplier and Channel Determining Oscillator coils calibrated in Mc and silk screened on top of shield cans; input impedance 50 ohms; signal strength 2 to 8 microvolts—10/1 Signal Noise Ratio; mfr CCI, Dwgs. nos. 327-R-E-102, 327-R-E-826 and 327-R-E-830; consists of: C101 through C146, E101 through E106, J101, J102, L113, L114, R101 through R124, T101, T102, TB101, XV101 through XV105, XY101, XY102, Z101 through Z108	RF chassis assembly
AR201	N16-A-39348-1018	AMPLIFIER-DETECTOR: plug-in assembly; includes 3 Mc IF Amplifier, Detector, 1st Audio Amplifier, Squelch, Automatic Gain Control circuit and Noise Limiter stage; voltage requirements: 6.3 v AC, 115 v DC; over-all max dim. 12 7/8" lg x 4" wide x 4 9/16" high; mounting: plugs into front frame mounted receptacle connector; held in place by four 10-32 Phillips truss head captive machine screws (2 in front and 2 at rear) which thread into frame mounted clinch standoffs; aluminum chassis; major components identified by symbol numbers silk screened on chassis; NOISE LIMITER switch, SQUELCH control and test points accessible on top of chassis; mfr CCI, Dwgs. nos. 327-R-E-103, 327-R-E-827 and 327-R-E-831; consists of: C201 through C227, E201 through E207, J201, R201 through R238, S201, T201 through T204, TB201 through TB203, XV201 through XV206	IF-chassis assembly
AR301	N16-A-39386-2501	AMPLIFIER-POWER SUPPLY: plug-in assembly; includes Audio Amplifier with output transformer and AC operated Power Supply (includes Power Transformer, Full-wave Selenium Rectifier and Choke Input-Capacitor Filter System); voltage requirements: 105, 115, or 125 v AC, 60 cycle; Power Supply Output 6.3 v AC at 5 amps and 235 v DC (filtered) at 85 ma; supplies power to all units of AN/FRR-27 Radio Receiving Set; Audio Amplifier provides 300 and 600 ohm impedance outlets; over-all max dim. 12 7/8" lg x 5 15/16" wide x 4 9/16" high; mounting: plugs into front frame mounted receptacle connector; held in place by four 10-32 Phillips truss head captive machine screws (2 in front and 2 at rear) which thread into frame mounted clinch standoffs; aluminum chassis; major components identified by symbol numbers silk screened on chassis; AF LEVEL control accessible on top of chassis; short coaxial cable, from J302 to P301 permits connection to RF sub-chassis assembly; fuses accessible from top of chassis; terminal board on bottom of chassis permits matching power transformer primary to 105, 115 or 125 v AC line; mfr CCI, Dwg. nos. 327-R-E-104, 327-R-E-828, 327-R-E-832; consists of C301 through C305, CR301, CR302, E301, E302, F301 through F303, J301, J302, L301, P301, R301 through R307, T301, T302, TB301, TB302, XC305, XF301, XF302, XV301, XV302	Audio/Power Supply chassis assembly

C101	N16-C-18661-1302	CAPACITOR, FIXED, CERAMIC DIELECTRIC: case style Ref Dwg CCI 130-019; 1,000 μμf +100% —0; variable temp coef; 600 v DC working; durez phenolic case, vacuum waxed jacket; case dim. 0.230-0.260" dia x 0.056-0.156" thick; 2 flexible wire radial terminals, 1" lg min; terminal mounted; mfr CBJS, Type B Discap	V101 cathode bypass
C102		Same as C101	V101 filament bypass
C103		Same as C101	V101 screen grid bypass
C104		Same as C101	V101 plate isolation bypass
C105	N16-C-15528-5828	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 3.0 μμf ±0.25 μμf; 500 v DC working; temp coef zero +250 parts/million/°C; ceramic uninsulated body; case dim. 0.4" lg max x 0.2" dia max; 2 axial wire leads, 1 1/4" lg min; terminal mtd; per Spec. JAN-C-20A, Type CC20CK030C; p/o Z101	Antenna coil padder
C106		Same as C101	V103 cathode bypass
C107		Same as C101	V103 screen grid bypass
C108	N16-C-19140-9551	CAPACITOR, FIXED, CERAMIC DIELECTRIC: case style Ref Dwg CCI 130-021; 10,000 μμf +80% —20%; variable temp coef; 600 v DC working; durez phenolic case, vacuum waxed jacket; case dim. 0.610-0.640" dia x 0.056-0.156" thick; 2 flexible wire terminals, 1 1/2" lg min; terminal mtd; mfr CBJS, Type B Discap	V104 oscillator plate bypass
C109		Same as C101	V201 grid leak bypass
C110		Same as C108	High voltage bypass
C111		Same as C101	V103 grid return bypass
C112		Same as C108	V104 filament bypass
C113		Same as C101	V104 oscillator grid coupling
C114		Same as C101	V102 screen grid bypass
C115		Same as C101	V102 filament bypass
C116		Same as C108	AGC bypass
C117		Same as C101	High voltage bypass
C118		Same as C101	V105 oscillator plate return bypass
C119		Same as C101	V105 filament bypass
C120	N16-C-27761-7201	CAPACITOR, FIXED, MICA DIELECTRIC: 56 μμf ± 5%; 500 v DC working; temp coef —200 to +200 parts/million/°C; molded case, dim. 51/64" lg max x 15/32" wide max x 7/32" thick max; 2 axial wire leads, 1 1/8" lg min; terminal mtd; per Spec. JAN-C-5, Type CM20C560J; p/o Z108	V104 oscillator plate coil padder

TABLE 8-2. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NUMBERS STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS
C121	For Replacement Use SNSN N16-C-58836-5282 Modified as indicated in description	CAPACITOR, VARIABLE, AIR DIELECTRIC: plate meshing type; one section; 23 $\mu\mu$f max to 4.0 $\mu\mu$f min; 600 v AC peak volts; over-all dim. excluding shaft and bushing 1 3/32" lg x 15/16" wide x 1 7/32" high; shaft 7/16" lg x 1/4" dia; screwdriver adjustment; 360° rotation; ceramic insulated base; 2 terminals, 1 post type and 1 solder lug type; 3 hole mtg, two 4-40 tapped mtg posts on 21/32" mtg centers; locknut for permanent setting; mfr CFW Type ARL-21; per Spec. JAN-C-92, Type CT1C025; modified by drilling No. 53 hole in shaft and inserting wire as pointer per CCI Dwg. 327-R-E-221; p/o Z101	Antenna coil trimmer
C122		Same as C121; p/o Z102	V101 grid coil trimmer
C123		Same as C121; p/o Z103	V101 plate coil trimmer
C124		Same as C121; p/o Z104	V102 grid coil trimmer
C125		Same as C121; p/o Z105	2nd RF multiplier coil trimmer
C126		Same as C121; p/o Z106	V105 multiplier plate coil trimmer
C127		Same as C121; p/o Z107	V105 oscillator plate coil trimmer
C128	N16-C-15368-5828	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1.0 $\mu\mu$f $\pm$0.25 $\mu\mu$f; 500 v DC working; temp coef zero + 250 parts/million/°C; ceramic uninsulated body; case dim. 0.4" lg max x 0.2" dia max; 2 axial wire leads, 1 1/4" lg min; terminal mounted; per Spec. JAN-C-20A, Type CC20CK010C	RF transformer coupling
C129		Same as C101	RF coupling to Z102
C130	N16-C-15432-5828	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 2.0 $\mu\mu$f $\pm$0.25 $\mu\mu$f; 500 v DC working; temp coef zero +250 parts/million/°C; ceramic uninsulated body; case dim. 0.4" lg max x 0.2" dia max; 2 axial wire leads, 1 1/4" lg min; terminal mounted; per Spec. JAN-C-20A, Type CC20CK020C	V102 grid injection coupling
C131		Same as C101	V103 plate bypass
C132	N16-C-18659-8953	CAPACITOR, FIXED, CERAMIC DIELECTRIC: case style No. 4, MBCA Ref Dwg Group 1; 1,000 $\mu\mu$f $\pm$20%; 600 v DC working; variable temp coef; insulated; ceramic case, dim. 11/16" lg x 5/16" dia; 2 rigid wire hooked end terminals, 1/4" lg; feedthru mtg with mtg bushing 9/32" lg, 12-28 thread; brass mtg nut, cadmium plated; mfr CBN, Type FT-1000 Hi Kaps; per Spec. MIL-C-11015A	V105 oscillator test point
C133		Same as C101	V105 multiplier grid coupling
C134	N16-C-30172-4410	CAPACITOR, FIXED, MICA DIELECTRIC: button type; case style Ref Spec. MS91105, Style CB21; 470 $\mu\mu$f $\pm$10%; temp coef —100 to +100 parts/million/°C; 300 v DC working; brass case, silver plated; case dim. 0.450" dia x 3/8" lg; 1 brass post terminal, silver plated, 9/16" lg on top of body; mtd. by one tapped hole, 3-48 thread, 7/64" deep, centrally located on bottom; mfr CER Type 370-FE; per Spec. MIL-C-10950A, Type CB21VD471K; p/o Z102	V101 RF grid coil bypass

C135	N16-C-30119-5075	CAPACITOR, FIXED, MICA DIELECTRIC: button type; case style Ref Spec. MS91105, Style CB21; 470 $\mu\mu$f ±20%; variable temp coef; 300 v DC working; brass case, silver plated; case dim. 0.450" dia x 3/8" lg; one offset terminal, brass, silver-plated, 3/8" lg; mtd by one tapped hole, 3-48 thread, 7/64" deep, centrally located on bottom; mfr CER Type 370-FF; per Spec. MIL-C-10950A, Type CB21TW471M.	V101 cathode bypass
C136		Same as C134; p/o Z103	V101 plate coil bypass
C137		Same as C134; p/o Z104	V102 grid coil bypass
C138		Same as C135	V102 cathode bypass
C139		Same as C134; p/o Z106	V105 multiplier plate coil bypass
C140		Same as C132	V104 oscillator test point
C141	N16-C-28553-1201	CAPACITOR, FIXED, MICA DIELECTRIC: 100 $\mu\mu$f ±5%; 500 v DC working; temp coef —200 to +200 parts/million/°C; molded case, dim. 51/64" lg max x 15/32" wide max x 7/32" thick max; 2 axial wire leads, 1 1/8" lg min; terminal mtd; per Spec. JAN-C-5, Type CM20C101J	V104 cathode bypass
C142	N16-C-27577-1401	CAPACITOR, FIXED, MICA DIELECTRIC: 47 $\mu\mu$f ±5%; 500 v DC working; temp coef —200 to +200 parts/million/°C; molded case, dim. 51/64" lg max x 15/32" wide max x 7/32" thick max; 2 axial wire leads, 1 1/8" lg min; terminal mtd; per Spec. JAN-C-5, Type CM20C470J; p/o T102	V103 plate coil padder
C143		Same as C142; p/o T102	V201 grid coil padder
C144		Same as C142; p/o T101	V103 grid coil padder
C145		Same as C120; p/o T101	V102 plate coil padder
C146		Same as C105; p/o Z102	V101 grid coil padder
C201		Same as C108	V201 cathode bypass
C202		Same as C108	V201 screen grid bypass
C203	N16-C-27181-4401	CAPACITOR, FIXED, MICA DIELECTRIC: 33 $\mu\mu$f ±5%; 500 v DC working; temp coef —200 to +200 parts/million/°C; molded case, dim. 51/64" lg max x 15/32" wide max x 7/32" thick max; 2 axial wire leads, 1 1/8" lg min; terminal mtd; per Spec. JAN-C-5, Type CM20C330J; p/o T201	V201 plate coil padder
C204		Same as C203; p/o T201	V202 grid coil padder
C205	N16-C-18983-9881	CAPACITOR, FIXED, CERAMIC DIELECTRIC: case style Ref Dwg CCI 130-020; 5,000 $\mu\mu$f +100% —0%; 600 v DC working; durez phenolic case, vacuum waxed jacket; case dim. 0.570-0.600" dia x 0.056-0.156" thick; 2 radial flexible wire terminals, 1 1/2" lg min; terminal mtd; mfr CBJS, Type B Discap	V202 grid return bypass
C206		Same as C108	V202 cathode bypass
C207		Same as C108	V202 screen grid bypass
C208		Same as C203; p/o T202	V202 plate coil padder

TABLE 8-2. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NUMBERS STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS
C209		Same as C203; p/o T202	V203 grid coil padder
C210		Same as C205	V203 grid return bypass
C211		Same as C108	V203 screen grid bypass
C212		Same as C203; p/o T203	V203 plate coil padder
C213		Same as C203; p/o T203	V204 grid coil padder
C214		Same as C108	V204 cathode bypass
C215		Same as C108	V204 screen grid bypass
C216		Same as C203; p/o T204	V204 plate coil padder
C217		Same as C203; p/o T204	V205 detector coil padder
C218		Same as C142	V206 audio shaping
C219	N16-C-30114-4276	CAPACITOR, FIXED, MICA-DIELECTRIC: 470 $\mu\mu$f, $\pm$10%; 500 v DC working; temp coef letter B; molded case; case dim. 51/64" lg max x 15/32" wide max x 7/32" thick max; 2 axial wire leads, 1 1/8" lg min; terminal mtd; per Spec. JAN-C-5, Type CM20B471K	V205 detector grid return bypass
C220(A) (B) (C)	N16-C-54402-7003	CAPACITOR ASSEMBLY: three capacitors; fixed; paper dielectric; each 50,000 $\mu\mu$f $\pm$20%; 600 v DC working; temp coef letter E; in metal case with common ground connection; case dim. 2 7/16" lg x 41/64" wide x 1 1/16" high, excluding terminals; 3 lug terminals, 3/4" max; 2 slotted mtg holes, 0.156" dia on 2 1/8" mtg centers; per Spec. JAN-C-25, Type CP69B5EF503M	(A) Low AGC bypass (B) V206 noise limiter time constant (C) V205 squelch grid bypass
C221		Same as C108	Squelch control bypass
C222		Same as C108	V203 cathode bypass
C223	N16-C-32250-9764	CAPACITOR, FIXED, MICA DIELECTRIC: 3300 $\mu\mu$f $\pm$10%; 500 v DC working; variable temp coef; molded case; case dim. 53/64" lg max x 53/64" wide max x 9/32" thick max; 2 axial wire leads, 1 1/8" lg min; terminal mtd; per Spec. JAN-C-5, Type CM30B332K	V206 plate coupling
C224	N16-C-31512-4564	CAPACITOR, FIXED, MICA DIELECTRIC: 1500 $\mu\mu$f $\pm$10%; 500 v DC working; variable temp coef; molded case; case dim. 53/64" lg max x 53/64" wide max x 9/32" thick max; 2 axial wire leads, 1 1/8" lg min; terminal mtd; per Spec. JAN-C-5, Type CM30B152K	V206 grid coupling
C225	N16-C-19958-9809	CAPACITOR, FIXED, ELECTROLYTIC: one section; 50 μfd; 50 v DC working; temp coef letter C; sealed metal case, dim. 2 1/2" lg x 1" wide x 15/16" high, excluding terminals; 2 solder lug terminals, 5/16" lg, mtd 1 1/16" C to C; 2 mtg holes, 3/16" dia on 2 1/8" mtg centers; per Spec. JAN-C-62, Type CE63C500G	V206 cathode bypass
C226		Same as C108	V205 squelch plate bypass
C227		Same as C108	V206 audio coupling
C301		Same as C219	V301 plate bypass

C302		Same as C224	V301 plate coupling
C303	N16-C-31908-1564	CAPACITOR, FIXED, MICA-DIELECTRIC: 2200 $\mu\mu$f $\pm$10%; 500 v DC working; variable temp coef; molded case; case dim. 53/64" lg max x 53/64" wide max x 9/32" thick max; 2 axial wire leads, 1 1/8" lg min; terminal mtd; per Spec. JAN-C-5, Type CM30B222K	V302 plate bypass
C304		Same as C225	V302 cathode bypass
C305(A) (B) (C)	N16-C-22489-5051	CAPACITOR, FIXED, ELECTROLYTIC: 3 section; 10-10-10 μfd; 450 v DC working; temp coef letter F; tubular metal case; case dim. 2 19/32" lg excluding terminals x 1 1/4" dia; 4 pin terminals, insulated from can; plugs into 11/16" dia pin circle, std med octal socket; per Spec. JAN-C-62, Type CE53F1Q0R	High voltage filters
C401		Same as C132	RF filter bypass
C402		Same as C108	RF filter bypass
C501		Same as C101	AC line bypass
C502		Same as C101	AC line bypass
C503		Same as C108	AC line bypass
C504		Same as C108	AC line bypass
C505		Same as C132	AC line bypass
C506		Same as C132	AC line bypass
C507		Same as C108	Audio line bypass
C508		Same as C108	Audio line bypass
C509		Same as C132	Audio line bypass
C510		Same as C132	Audio line bypass
CR301	N17-R-51504-1001	RECTIFIER, METALLIC: selenium; single phase, voltage doubler (used as one half of a full wave rectifier system); MBCA Ref Dwg Group 23, Style no. 3; input 320 v AC; output 300 v DC working; 75 ma. max current; full wave rectification; rectangular shape; salt spray resistant; over-all dim. 1 5/8" lg x 1 13/32" high, including terminals x 1" wide; mtd by one no. 8 screw hole running axially through stack; 3 terminals, solder lug type, located each end of stack and center; center cooled with protective end plates; mfr CBGB, Type 78-D	High voltage rectifier
CR302		Same as CR301	High voltage rectifier
E101	N16-S-34520-3864	SHIELD, ELECTRON TUBE: brass, nickel plated; cylindrical shape; over-all dim. 1 3/8" high x 0.930" dia; friction mtd; per Spec. JAN-S-28A, Type TS102U01	V101 tube shield
E102		Same as E101	V102 tube shield
E103	N16-S-34557-8351	SHIELD, ELECTRON TUBE: brass, nickel plated; cylindrical shape; over-all dim. 1 3/4" high x 0.930" dia; friction mtd; per Spec. JAN-S-28A, Type TS102U02	V103 tube shield

TABLE 8-2. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NUMBERS STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS
E104	For replacement use SNSN N16-S-34576-6514	SHIELD, ELECTRON TUBE: brass, nickel plated; cylindrical shape; over-all dim. 1 15/16" high x 1.065" dia; friction mtd; per Spec. JAN-S-28A, Type TS103U02	V104 tube shield
E105		Same as E104	V105 tube shield
E106	Shop manufacturer	CONTACT, ELECTRICAL: RF inter-chassis connector; consists of conducting spring and mtg board; conducting spring beryllium copper, silver plated, 1 3/16" lg x 5/16" wide x 0.010" thick; mtg board Silicone glass base bakelite, 1" lg x 7/16" wide x 1/16" thick; over-all contact dim. 1" lg x 7/8" high x 3/8" thick; spring contact drilled at one end to provide solder terminal; contact mtd by two no. 30 holes, 3/4" C to C; mfr CCI per Dwg Nos. 327-C-221X and 327-C-222	RF contact between RF and IF chassis
E201		Same as E103	V201 tube shield
E202		Same as E103	V202 tube shield
E203		Same as E103	V203 tube shield
E204		Same as E103	V204 tube shield
E205		Same as E103	V205 tube shield
E206		Same as E104	V206 tube shield
E207		Same as E106	IF contact between IF and RF chassis
E301		Same as E103	V301 tube shield
E302	N16-S-34607-6039	SHIELD, ELECTRON TUBE: brass, nickel plated; cylindrical shape; over-all dim. 2 1/4" high x 0.930" dia; friction mtd; per Spec. JAN-S-28A, Type TS102U03	V302 tube shield
E501	N17-S-250051-153	SHELL, ELECTRICAL CONNECTOR: brass, silver plated; square; over-all dim. 3/4" lg x 1" wide x 1" high; mtd by 4 holes, 1/4" dia on 23/32" mtg centers; per Spec. MIL-C-71A, Type UG-177/U; used with J501	Shielding hood for J501 connector
E601	If failure occurs, requisition a replacement part from ESO, referencing NavShips 900180a as authority	SHELL, ELECTRICAL CONNECTOR: case of die cast aluminum with tin plate and clear lacquer finish; rectangular; over-all dim. 2 43/64" lg x 2 11/16" wide x 1 11/16" high; mounted by 4 holes, no. 27 drill on 2.188" x 1" mtg centers; mfr CED, Type DPB-34; p/o W601	Shell for J504 connector, used with test cable
E602	If required, will be procured by nearest Navy Shore Supply Activity on demand	SHELL, ELECTRICAL CONNECTOR: case of die cast aluminum with tin plate and clear lacquer finish; rectangular; over-all dim. 2" lg x 2 11/16" wide x 1 11/16" high; mtd by 4 holes, no. 27 drill on 2.188" x 1" mtg centers; mfr CED, Type DPB-33, p/o W601	Shell for J302 connector, used with test cable
F301	N16-F-16302-80	FUSE, CARTRIDGE: rated at 1 amp, 250 v max; time lag type; 0-1 hour blowing time for 135% overload, 6 seconds min for 300% overload; glass case; brass ferrules, silver-plated; over-all dim. 1 1/4" lg x 1/4" dia; per Spec. MIL-F-15160A, MS90078, Type F02G1R00B; used with XF301	AC power line

F302		Same as F301; used with XF302	AC power line
F303		Same as F301	Spare fuse for AC power lines
I401	G17-L-6806-130	LAMP, GLOW: 1/25 watt; 65 v AC striking voltage; 95 v DC striking voltage; lamp style MBCA Ref Dwg Group 7, Type 4; miniature bayonet base; type T-3 1/4 blub, clear; 2 electrodes, W-11 type; over-all height 1 3/16" max; 3000 hours rated life; mfr CG Type NE51	Power indicator
J101	N17-C-73108-1267	CONNECTOR, RECEPTACLE: 1 round female coaxial contact; straight; radio frequency connector, not constant-impedance but minimum electrical discontinuity at 50 ohms; rated at 500 v peak; round metal body, dim. 11/32" dia x 27/32" lg with mtg flange 11/16" square; weatherproof; mtg by 4 holes, no. 3-56 thread; spaced 1/2" C to C; per Spec. MIL-C-3608, Type UG-290/U; used with P301	Antenna RF connector
J102	N17-C-73615-4692	CONNECTOR, RECEPTACLE: 20 round male contacts, four no. 16 and sixteen no. 20, brass, gold plated; rated at 500 v rms; polarized; with barriers; straight; rectangular; over-all dim. 3/8" lg, excluding terminals x 3/4" wide x 1 15/16" high; molded, mica-filled phenolic; mtd by two holes for no. 4 screws on 1.62" mtg centers; mfr CPH Type 26-806; used with J401	Inter-unit connector for RF chassis
J201		Same as J102; used with J402	Inter-unit connector for IF chassis
J301		Same as J102; used with J403	Inter-unit connector for Audio/ Power Supply chassis
J302	N17-C-73569-8951	CONNECTOR, RECEPTACLE: 10 round male contacts, six 15 amp, two 30 amp, two 10 amp coaxial; polarized, straight; rectangular; over-all dim. 1 7/64" lg, excluding protruding contacts x 2 11/16" wide x 1 11/16" high; case aluminum alloy with tin plate and clear lacquer finish; molded melamine insert; mtd by 4 holes, 0.144" dia on 1" x 2 3/16" mtg centers; mfr CED, Type DPB-A10C2-34P; used with J504	Audio/Power Supply chassis, interconnects to filter assembly
J401	For replacement use SNSN N17-C-73323-3220	CONNECTOR, RECEPTACLE: 20 round female contacts, four no. 16 and sixteen no. 20, beryllium copper, gold plated; rated at 500 v rms; polarized: with barriers; straight; rectangular; over-all dim. 3/8" lg, excluding terminals x 3/4" wide x 1 15/16" high; molded mica filled phenolic; mtd by two holes, for no. 4 screws on 1.62" mtd centers; mfr CPH, Type 26-807; used with J102	Inter-unit connector for RF chassis
J402		Same as J401; used with J201	Inter-unit connector for IF chassis
J403		Same as J401; used with J301	Inter Unit connector for Audio/ Power Supply chassis
J404	N17-J-39248-4418	JACK, TELEPHONE: for 2-conductor plug, w/shank dim. 1/4" dia x 1 3/16" lg; contact arrangement MBCA Ref Dwg Group 4, Type J1, tip and sleeve; over-all dim. 1 13/64" lg x 15/16" dia max; mtd by 3/8"-32 thread bushing; mtg accessories include 1 brass, nickel plated locknut, 1 brass, nickel plated washer; per Spec. Jan-J-641, Type JJ-034	Panel headphone jack
J501	N17-C-73108-5906	CONNECTOR, RECEPTACLE: 1 round male contact; radio frequency connector; 50 ohms constant impedance; 500 v peak; straight; metal body, solid shell; over-all dim. 1 7/64" lg x 1" square; threaded sleeve with hex nut; cable opening 0.285" dia max; panel mtg by 4 holes, 1/4" dia on 23/32" mtg centers; per Spec. MIL-C-71A, Type UG-58 A/U; used with P501	Antenna receptacle, rear panel assembly

TABLE 8-2. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NUMBERS STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS
J502	For replacement use SNSN N17-C-70319-1800	CONNECTOR, RECEPTACLE: 2 round male pin contacts, no. 16-20 amp; polarized; straight; over-all dim 27/32" lg excluding protruding terminals x 1" square; rated 200 v DC, 150 v AC; box mtg type, with coupling, threaded 5/8"-24 thread; 4 mtg holes, 0.147" dia on 23/32" mtg centers; cylindrical metal body with mtg flange; molded phenolic insert; solid shell; per Spec. MIL-C-5015, Type AN-3102A-10SL-4P; used with P502	AC power receptacle
J503	For replacement use SNSN N17-C-70326-9330	CONNECTOR, RECEPTACLE: 3 round male pin contacts, no. 16-20 amp; polarized; straight; over-all dim. 27/32" lg, excluding protruding terminals x 1" square; rated 200 v DC, 150 v AC; box mtg type, solid shell, with threaded coupling, 5/8"-24 thread; 4 mtg holes, 0.147" dia on 23/32" mtg centers; cylindrical metal body, with mtg flange; molded phenolic insert; per Spec. MIL-C-5015, Type AN-3102A-10SL-3P; used with P503	Audio receptacle, rear panel assembly
J504	N17-C-73285-6012	CONNECTOR, RECEPTACLE: 10 round female contacts, 6-15 amp, 2-30 amp and 2-10 amp coaxial; polarized; rectangular; straight; over-all dim. 63/64" lg, excluding protruding contacts x 2 11/16" wide x 1 11/16" high; case of aluminum alloy with tin plate and clear lacquer coating; molded melamine insert; mtd by 4 holes, 0.144" dia on 1" x 2 3/16" mtg centers; mfr CED, Type DPB-A10C2-33S; used with J302	Audio, power and RF receptacle rear panel assembly
L101	For reference only	COIL, RADIO FREQUENCY; p/o Z101	Antenna coil
L102	For reference only	COIL, RADIO FREQUENCY; p/o Z102	V101 grid coil
L103	For reference only	COIL, RADIO FREQUENCY; p/o Z103	V101 plate coil
L104	For reference only	COIL, RADIO FREQUENCY; p/o Z104	V102 grid coil
L105	For reference only	COIL, TRANSFORMER; p/o T102	23 Mc primary
L106	For reference only	COIL, TRANSFORMER; p/o T102	23 Mc secondary
L107	For reference only	COIL, RADIO FREQUENCY; p/o Z108	V104 plate coil
L108	For reference only	COIL, TRANSFORMER; p/o T101	23 Mc secondary
L109	For reference only	COIL, TRANSFORMER; p/o T101	23 Mc primary
L110	For reference only	COIL, RADIO FREQUENCY; p/o Z105	2nd Multiplier coil of V105
L111	For reference only	COIL, RADIO FREQUENCY; p/o Z106	1st Multiplier coil of V105
L112	For reference only	COIL, RADIO FREQUENCY; p/o Z107	V105 oscillator coil
L113	N16-C-72911-7481	CHOKE, RADIO FREQUENCY: 3 μh; bakelite coil form; cylindrical shape; over-all dim. 3/16" dia x 3/4" lg, excluding terminals; 2 axial wire terminals; terminal mtd; mfr CCI, Dwg. No. 327-R-E-306	Coupling between Z101 and Z102 RF Coils
L114		Same as L113	Coupling between Z106 and Z105 Multiplier coils
L201	For reference only	COIL, TRANSFORMER; p/o T201	V201—3 Mc plate coil
L202	For reference only	COIL, TRANSFORMER; p/o T201	V202—3 Mc grid coil

L203	For reference only	COIL, TRANSFORMER; p/o T202	V202—3 Mc plate coil
L204	For reference only	COIL, TRANSFORMER; p/o T202	V203—3 Mc grid coil
L205	For reference only	COIL, TRANSFORMER; p/o T203	V203—3 Mc plate coil
L206	For reference only	COIL, TRANSFORMER; p/o T203	V204—3 Mc grid coil
L207	For reference only	COIL, TRANSFORMER; p/o T204	V204—3 Mc plate coil
L208	For reference only	COIL, TRANSFORMER; p/o T204	V205—3 Mc detector plate coil
L301	N16-R-29236-8021	REACTOR: filter choke; one section; inductance 10 henries +50% —20%; current rating 100 ma, DC; direct current resistance 150 ohms ±15%; insulation test voltage 1500 v rms; peak working voltage 535 v; steel, enclosed case, electro tin plate finish; over-all dim. MBCA Ref Dwg Group 12, 3 1/4" lg x 2 5/8" wide x 2 7/8" high; mtg by 4 weldbolts, no. 8-32 thread x 3/8" lg on 2 1/2" x 1 7/8" mtg centers; 2 post terminals, located on bottom and numbered 1 and 2; mfr CADF, Type 88C2; CCI Dwg. No. 327-C-302	High voltage filter choke
L401		Same as L113	Headphone RF filter choke
L501	N16-C-74484-9020	CHOKE, RADIO FREQUENCY: attenuates frequencies between 2-40 Mc; cylindrical shape; over-all dim. 13/16" dia x 1 9/16" lg, excluding terminals; 2 wire terminals, located at each end; mtd by no. 5-40x2" machine screw through center of iron core slugs; powdered iron core; not adjustable; mfr CCI, Dwg no. 327-R-E-309	Power line low frequency filter choke
L502		Same as L501	Power line low frequency filter choke
L503	N16-C-72745-1875	CHOKE, RADIO FREQUENCY: attenuates frequencies between 40-200 Mc; cylindrical shape; over-all dim. 1/4" dia x 1" lg, excluding terminals; 2 wire terminals, located axially at each end; terminal mounted; bakelite coil form; mfr CCI, Dwg. no. 327-R-E-308	Power line high frequency filter choke
L504		Same as L503	Power line high frequency filter choke
L505		Same as L501	Audio Line low frequency filter choke
L506		Same as L501	Audio line low frequency filter choke
L507		Same as L503	Audio line high frequency filter choke
L508		Same as L503	Audio line high frequency filter choke
P301	For replacement use SNSN N17-C-71408-3521	CONNECTOR, PLUG: 1 round male contact; straight; radio frequency connector, not constant impedance, but minimum electrical discontinuity at 50 ohms; rated at 500 v peak; round metal body, bayonet locking type; weatherproof; over-all dim. 31/32" lg x 9/16" dia; per Spec. MIL-C-3608, Type UG-88/U; used with J101	Antenna interunit connector

TABLE 8-2. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NUMBERS STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS
P501	For replacement use SNSN N17-C-71419-9699	CONNECTOR, PLUG: 1 round male coaxial contact; straight; radio frequency connector, 50 ohms impedance; rated at 500 v peak; round, metal body, dim. 13/16" dia x 1 3/4" lg; weatherproof; per Spec. MIL-C-71A, Type UG-21 B/U; used with J501	Antenna coaxial connector
P502	For replacement use SNSN N17-C-72595-1800	CONNECTOR, PLUG: 2 round female contacts, no. 16, 20 amp; polarized; straight; over-all dim. 7/8" dia x 1 5/16" lg; rated 200 v DC, 150 v AC; round metal body; solid shell; per Spec. MIL-C-5015, Type AN-3106A-10SL-4S; used with J502	AC power plug
P503	N17-C-70326-9330	CONNECTOR, PLUG: 3 round female contacts, no. 16, 20 amp; polarized; straight; over-all dim. 7/8" dia x 1 5/16" lg; rated 200 v DC, 150 v AC; round metal body; solid shell; per Spec. MIL-C-5015, Type AN-3106A-10SL-3S; used with J 503	Audio line plug
P601		Same as J504; p/o W601	Test cable connector
P602		Same as J302; p/o W601	Test cable connector
R101	N16-R-50822-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 470,000 ohms ±10%; 1/2 watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mounted; per Spec. JAN-R-11, Type RC20BF474K	V101 AGC isolation
R102		Same as R101	V102 grid
R103	N16-R-49769-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 470 ohms ±10%; 1/2 watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mounted; per Spec. JAN-R-11, Type RC20BF471K	V103 cathode
R104		Same as R103	V104 oscillator cathode
R105	N16-R-50129-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 4,700 ohms ±10%, 1/2 watt; F characteristic; dim. 0.406" lg x 0.175. dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mtd; per Spec. JAN-R-11, Type RC20BF472K	V102 cathode
R106	N16-R-50480-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 47,000 ohms ±10%; ½ watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mounted; per Spec. JAN-R-11, Type RC20BF473K	V101 screen grid bleeder
R107		Same as R106	V103 screen grid bleeder
R108	N16-R-50372-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 22,000 ohms ±10%; 1/2 watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mtd; per Spec. JAN-R-11, Type RC20BF223K	V105 oscillator grid

R109	N16-R-50633-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 100,000 ohms ±10%; 1/2 watt; F Characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; "typical mfgr" International Resistance Co., Philadelphia, Pa.; per Spec. JAN-R-11, Type RC20BF104K	V201 grid
R110		Same as R109	V103 AGC isolation
R111	N16-R-49661-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 220 ohms ±10%; 1/2 watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; "typical mfgr" International Resistance Co., Philadelphia, Pa.; per Spec. JAN-R-11, Type RC20BF221K	V104 oscillator cathode
R112		Same as R111	V105 oscillator cathode
R113	N16-R-49922-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 1,000 ohms ±10%; 1/2 watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mounted; per Spec. JAN-R-11, Type RC20BF102K	V105 oscillator plate isolation
R114		Same as R113	V105 multiplier plate isolation
R115		Same as R113	V101 plate isolation
R116	N16-R-50201-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 6,800 ohms ±10%; 1/2 watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mtd; per Spec. JAN-R-11, Type RC20BF682K	V104 oscillator plate
R117		Same as R113	V105 oscillator cathode
R118	N16-R-50373-0231	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 22,000 ohms ±10%; ½ watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mounted; per Spec. JAN-R-11, Type RC20BF223K	V104 oscillator grid
R119	N16-R-50975-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 1 meg ±10%; 1/2 watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mounted; per Spec. JAN-R-11, Type RC20BF105K	V104 test point isolation
R120		Same as R119	V105 test point isolation
R121	N16-R-50282-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dfg Group 2, body style 14; 10,000 meg ±10%; ½ watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mounted; per Spec. JAN-R-11, Type RC20BF103K	V102 screen grid and plate isolation
R122	N16-R-49877-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 820 ohms ±10%; 1/2 watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mtd; per Spec. JAN-R-11, Type RC20BF821K	V101 cathode
R123		Same as R108	V103 plate and screen grid
R124		Same as R108	V101 screen grid dropping

TABLE 8-2. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NUMBERS STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS
R201	N16-R-49967-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 1500 ohms ±10%; 1/2 watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mtd; per Spec. JAN-R-11, Type RC20BF152K	V201 cathode
R202	N16-R-51038-811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 1.8 meg ±10%; ½ watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mtd; per Spec. JAN-R-11, Type RC20BF185K	V205 squelch grid
R203		Same as R109	V202 AGC isolation
R204		Same as R108	V206 audio cathode
R205	N16-R-50373-0231	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 22,000 ohms ±10%; 1 watt; F characteristic; dim. 0.750" lg x 0.280" dia. insulated; salt water immersion resistant; 2 axial wire leads; terminal mtd; per Spec. JAN-R-11, Type RC30BF223K	V202 plate and screen grid isolation
R206		Same as R109	V203 AGC isolation
R207	N16-R-50012-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 2,200 ohms ±10%; 1/2 watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads, terminal mtd; per Spec. JAN-R-11, Type RC20BF222K	V203 plate and screen grid isolation
R208		Same as R111	V204 cathode
R209		Same as R113	V204 plate and screen isolation
R210		Same as R119	V206 noise limiter time constant
R211		Same as R109	B plus dropping
R212		Same as R111	V203 cathode
R213		Same as R119	AGC delay voltage dropping
R214		Same as R101	V206 1st audio grid
R215	N16-R-50552-0811	RESISTOR, FIXED, COMPOSITION: 68,000 ohms ±10%; 1/2 w; F characteristic; 0.468" lg x 0.249" dia; insulated; salt water immersion resistant; 2 axial wire leads; per Spec. JAN-R-11, Type RC20BF683K	Part of V206 voltage divider
R216	N16-R-87679-3469	RESISTOR, VARIABLE: composition; 1 section; 100,000 ohms, ±10%; 2 watts; JAN-A taper, clockwise rotation; normal torque; metal enclosed case; 3 solder lug terminals; case dim. 1 3/32" dia x 27/32" deep max, excluding mtg bushing and shaft; shaft 1/4" dia x 5/8" lg, slotted for depth of 0.531"; mounted by bushing 3/8" dia—32 NEF-2 thread by 0.375" long; mfr CTC type 95; per Spec. JAN-R-94, RV4ATSC104A	Squelch threshold control
R217		Same as R119	AGC time constant

R218	N16-R-50714-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 220,000 ohms ±10%; 1/2 w; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mounted; per Spec. JAN-R-11, Type RC20BF224K	V206 audio plate load
R219		Same as R106	V201 plate and screen grid isolation
R220	N16-R-50417-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 33,000 ohms ±10%; 1/2 watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mounted; per Spec. JAN-R-11, Type RC20BF333K	V205 detector load
R221		Same as R109	V205 detector load
R222		Same as R119	V205 squelch load
R223		Same as R121	V202 stabilizing
R224		Same as R119	V206 noise limiter load
R225	N16-R-51020-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 1.5 megohms ±10%; 1/2 watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mounted; per Spec. JAN-R-11, Type RC20BF155K	V205 grid
R226	N16-R-49706-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 330 ohms ±10%; 1/2 watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mounted; per Spec. JAN-R-11, Type RC20BF331K	V202 cathode
R227		Same as R218	V206 plate dropping
R228		Same as R218; p/o T201	V201 plate coil loading
R229		Same as R218; p/o T201	V202 grid coil loading
R230		Same as R218; p/o T202	V202 plate coil loading
R231		Same as R218; p/o T202	V203 grid coil loading
R232		Same as R218; p/o T203	V203 plate coil loading
R233		Same as R218; p/o T203	V204 grid coil loading
R234		Same as R218; p/o T204	V204 plate coil loading
R235		Same as R218; p/o T204	V205 detector coil loading
R236		Same as R108	V206 audio dropping
R237	N16-R-51398-816	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 20 megohms ±10%; ½ watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mounted; per Spec. JAN-R-11, Type RC20BF206K	V205 squelch plate
R238		Same as R101	V206 audio voltage divider

TABLE 8-2. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NUMBERS STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS
R301	For replacement use SNSN N16-R-88179-4482	RESISTOR, VARIABLE: composition; 1 section; 500,000 ohms ±10%; 2 watts; JAN-C taper; clockwise rotation; normal torque; metal, enclosed case; 3 solder lug terminals; case dim. 1 5/32" dia x 25/32" deep max excluding mtg bushing and shaft; shaft 1/4" dia x 3/4" lg, slotted for depth of 0.063"; single hole mtg by bushing, 3/8" dia—32 NEF-2 thread x 3/8" lg; mfr CTC, Type 95; per Spec. JAN-R-94, Type RV4ATSC504C	AF LEVEL control
R302		Same as R105	V301 cathode
R303		Same as R218	V301 plate load
R304	N16-R-51065-0811	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 2.2 megohms ±10%; 1/2 watt; F characteristic; dim. 0.406" lg x 0.175" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mtd; per Spec. JAN-R-11, Type RC20BF225K	Audio degeneration
R305		Same as R218	V302 grid
R306	For replacement use SNSN N16-R-49707-0511	RESISTOR, FIXED, COMPOSITION: MBCA Ref Dwg Group 2, body style 14; 330 ohms ±10%; 2 watts; F characteristic; dim. 0.750" lg x 0.370" dia; insulated; salt water immersion resistant; 2 axial wire leads; terminal mtd; per Spec. JAN-R-11, Type RC42BF331K	V302 cathode
R307		RESISTOR, FIXED, WIRE WOUND: MBCA Ref Dwg Group 2, body style 12; 4,000 ohms ±5%; 15 watts; G characteristic; dim. 1 1/4" lg x 1 3/16" wide x 21/32" thick, excluding terminals and mtg bar; fused vitreous enamel insulation; resistant to humidity and salt water; 2 tab terminals, mtd by metal through-bar 2 1/2" lg, with two 0.196" dia mtg holes on 2" mtg centers; mfr CHD Type BR113; per Spec. MIL-R-26B, Type RW20G402	Voltage dropping—B plus
R401		RESISTOR, VARIABLE: composition; 1 section; 50,000 ohms ±10%; 2 watts; JAN-F taper; counter-clockwise rotation; normal torque; metal, enclosed case; 3 solder lug terminals; case dim. 1 3/32" dia x 27/32" deep max, excluding mtg bushing and shaft; shaft 1/4" dia x 3/4" lg, slotted for depth of 0.063"; single hole mtg by bushing 3/8" dia—32 NEF-2 thread x 3/8" lg; mfr CTC, Type 95; per Spec. JAN-R-94, Type RV4ATSC503E	Headphone level control
S201	N17-S-70412-4406	SWITCH, TOGGLE: SPST; 40 amps; 125 v; metal body; over-all dim. 1 1/16" lg max, excluding bushing and handle x 41/64" wide x 1 9/64" high; bat handle, 11/16" lg; 2 solder lug terminals; single hole mtg by bushing 15/32" dia-32 thread x 15/32" lg, provided with two hex mtg nuts; per Spec. JAN-S 23, Type ST42A	Noise Limiter—ON-OFF
S401	N17-S-72828-2605	SWITCH, TOGGLE: 30 amps, 125 v; metal body; over-all dim. 1 1/16" lg max, excluding bushing and handle x 49/64" wide x 1 21/64" high max; bat handle, 11/16" lg; 4 solder lug terminals; DPST; single hole mtg by bushing 15/32" dia—32 thread x 15/32" lg, provided with two hex mtg nuts; per Spec. JAN-S-23, Type ST52K	AC power line, ON-OFF
S402		SWITCH, PUSH: SPST; single "make" type momentary contact; normally closed; molded phenolic housing and button; black button; rated 1/2 amp, 115 v AC; non-inductive; over-all dim. 1 17/32" lg, including terminals and actuating button x 51/64" dia max; single hole mtg; bushing 15/32" dia—32 NS-2 thread x 3/8" lg with hex mtg nuts; two solder lug terminals; mfr CBDW, Type 4002	Squelch TEST, In-Out

T101	N17-T-68220-1442	TRANSFORMER, INTERMEDIATE FREQUENCY: 23 Mc peak frequency; input; shielded; over-all dim. 1 7/16" square x 3 5/32" high, excluding terminals and tuning screws; phenolic coil form; powdered iron core; double tuned; adjustable iron core tuning; primary padder capacitor 56 $\mu\mu$f; secondary padder capacitor 47 $\mu\mu$f; mtg by two no. 4-40 threaded rods on 1 3/8" mtg centers; 4 solder lug terminals, located on bottom; mfr CCI, Dwg no. 327-R-E-320; consists of L108, L109, C144, C145	1st—23 Mc IF
T102	N17-T-68220-1443	TRANSFORMER, INTERMEDIATE FREQUENCY: 23 Mc peak frequency; output; shielded; over-all dim. 1 7/16" square x 3 5/32" high, excluding terminals and tuning screws; phenolic coil form powdered iron core; double tuned; adjustable iron core tuning; primary padder capacitor 47 $\mu\mu$f; secondary padder capacitor 47 $\mu\mu$f; mtg by two no. 4-40 threaded rods on 1 3/8" mtg centers; 4 solder lug terminals, located on bottom; mfr CCI, Dwg no. 327-R-E-323; consists of L105, L106, C142, C143	2nd—23 Mc IF
T201	N17-T-67809-7962	TRANSFORMER, INTERMEDIATE FREQUENCY: 3 Mc peak frequency; shielded; used as input, interstage and output; over-all dim. 1 7/16" square x 3 5/32" high, excluding terminals and tuning screws; phenolic coil form; powdered iron core; double tuned; adjustable iron core tuning; primary padder capacitor 33 $\mu\mu$f, resistor 220,000 ohms; secondary: padder capacitor 33 $\mu\mu$f, resistor 220,000 ohms; mtd by two no. 4-40 threaded rods on 1 3/8" mtg centers; 4 solder lug terminals, mfr CCI, Dwg No. 327-R-E-321; consists of: L201, L202, C203, C204, R228, R229	1st—3 Mc IF
T202		Same as T201; consists of L203, L204, C208, C209, R230, R231	2nd—3 Mc IF
T203		Same as T201: consists of L205, L206, C212, C213, R232, R233	3rd—3 Mc IF
T204		Same as T201: consists of L207, L208, C216, C217, R234, R235	4th—3 Mc IF
T301	N17-T-73688-3591	TRANSFORMER, POWER, STEP-DOWN AND STEP-UP: steel, enclosed case; electro tin plate finish; input voltage 105/115/125 v AC, 60 cycle, single phase; two output windings; no. 1 secondary winding, center-tapped, with output of 450 v—85 ma. and a 2nd tap with output of 75 v rms from center tap; no. 2 secondary winding with output of 6.3 v—5 amp; impregnating material "Petrocene A" Socony Vacuum Oil Co.; dim MBCA Ref Dwg Group 12, 3 5/8" lg x 3 3/16" wide x 3 1/4" high; 10 post terminals, located on bottom and numbered 1 through 10; mtg by four weldbolts, no. 8-32 thread x 3/8" lg on 2 13/16" x 2 1/2" mtg centers; grounded electrostatic shield; mfr CADF, Type 88P5; CCI Dwg No. 327-C-302	AC power
T302	N17-T-64535-9171	TRANSFORMER, AUDIO FREQUENCY: plate coupling type; primary impedance 5,000 ohms; secondary impedances: no. 1 winding 300 ohms, center-tapped; no. 2 winding 600 ohms; primary DC rating .045 amps; peak working voltages: primary 122 v, secondary no. 2-4.25 v, secondary no. 1-30.0 v; upright steel case, electro tin plated; core material dynamo anneal steel; over-all dim. MBCA Ref Dwg Group 12, 2 5/16" lg x 2 1/16" wide x 3 1/8" high; 1 1/2 watts max audio operating level; ratio of turns, primary to secondary no. 1—4.05 to 1; primary to secondary no. 2—28.33 to 1; frequency response $\pm$3 db from 200—3,000 cycles; 8 post terminals located on bottom and numbered 1 through 8; mtd by four no. 6-32 x 3/8" lg weld-bolts on 1 7/16" x 1 11/16" mtg centers; grounded electrostatic internal shield; mfr CADF, Type 88A10; CCI Dwg. No. 327-C-301	Audio output

TABLE 8-2. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NUMBERS STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS
TB101	Shop manufacture	TERMINAL BOARD: silicone glass base bakelite; 22 terminals, miniature, hollow swaged type, silver plated; without barriers; over-all dim. including terminals and standoffs 3 7/16" lg x 1 3/8" wide x 13/16" high; mtd by two Dural aluminum clinch standoffs, threaded for no. 6-32 Phillips machine screws on 2 1/2" mtg centers; mfr CCI Dwg. no. 327-R-E-201	RF chassis mounting
TB201	Shop manufacture	TERMINAL BOARD: silicone glass base bakelite; 70 terminals, miniature, hollow swaged type, silver plated; without barriers; over-all dim. including terminals and standoffs 11 1/2" lg x 1" wide x 13/16" high; mtd by five Dural aluminum clinch standoffs, threaded for no. 6-32 Phillips machine screws on 2 1/2" mtg centers; mfr CCI Dwg. no. 327-R-E-202	IF chassis mounting
TB202	Shop manufacture	TERMINAL BOARD: silicone glass base bakelite; 34 terminals, miniature, hollow swaged type, silver plated; without barriers; over-all dim. including terminals and standoffs 5 7/8" lg x 1" wide x 13/16" high; mtd by three Dural aluminum clinch standoffs, threaded for no. 6-32 Phillips machine screws on 2 1/8" mtg centers; mfr CCI Dwg. no. 327-R-E-206	IF chassis mounting
TB203	Shop manufacture	TERMINAL BOARD: silicone glass base bakelite; 6 terminals, miniature, hollow swaged type, silver plated; without barriers; over-all dim. including terminals and standoff 15/16" lg x 1" wide x 13/16" high; mounted by one Dural aluminum clinch standoff, threaded for no. 6-32 Phillips machine screw through center of terminal board; mfr CCI Dwg. no. 327-R-E-207	IF chassis mounting
TB301	Shop manufacture	TERMINAL BOARD: silicone glass base bakelite; 4 terminals, 3-clinch standoff type with 6-32 Phillips truss head machine screws, 1-clinch standoff type with 6-32 Phillips truss head machine screw and jumper bar; terminal standoffs brass, silver plated; over-all dim. excluding screws and solder lugs 2 1/4" lg x 1 1/8" wide x 11/16" high; mtd by two no. 25 drill holes on 1 3/4" mtg centers; 3 terminals black silk screened "105", "115" and "125", center terminal "C"; solder lugs attached under 4 terminals; mfr CCI, Dwg. nos. 327-R-E-205, 327-R-E-212, 327-R-E-617	AC input switching terminal board—Audio/Power Supply chassis
TB302		Same as TB101	Audio/Power Supply chassis mounting
V101	N16-T-75654	ELECTRON TUBE: RF pentode, sharp cutoff; T-5 1/2, glass envelope; miniature button 7-pin base; "Reliable Type"; per Spec. JAN-1A, Type JAN-5654	RF amplifier
V102		Same as V101	First mixer
V103	N16-T-75749	ELECTRON TUBE: RF amplifier pentode, remote cutoff; T-5 1/2, glass envelope; miniature button 7-pin base; "Reliable Type"; per Spec. JAN-1A, Type JAN-5749	23 Mc IF
V104	N16-T-58240-14	ELECTRON TUBE: twin triode; T-6 1/2, glass envelope; small button 9-pin base; "Reliable type"; per Spec. JAN-1A, Type JAN-6201/12AT7WA	20 Mc oscillator
V105		Same as V104	Channel Determining Oscillator —Multiplier

V201	N16-T-56203-53	ELECTRON TUBE: RF pentode, sharp cutoff; T-5 1/2, glass envelope; miniature button, 7-pin base; "Reliable Type"; per Spec. JAN-1A, Type JAN-6AU6WA	Second mixer
V202		Same as V103	First 3 Mc IF
V203		Same as V103	Second 3 Mc IF
V204		Same as V201	Third 3 Mc IF
V205	N16-T-56203-60	ELECTRON TUBE: duplex diode, high mu triode; T-5 1/2, glass envelope; miniature button 7-pin base; "Reliable Type"; per Spec. JAN-1A, Type JAN-6AV6	Squelch-Detector-AGC
V206		Same as V104	Noise Limiter—First Audio
V301		Same as V205	Second Audio amplifier
V302	N16-T-76005	ELECTRON TUBE: beam-power amplifier; T-5 1/2, glass envelope; miniature button 7-pin base "Reliable Type"; per Spec. JAN-1A, Type JAN-6005/6AQ5W	Audio Output
W601	Assemble from component parts	CABLE ASSEMBLY, SPECIAL PURPOSE: five conductor, in vinylite tubing; terminating at each end in 10-pin connectors; over-all length 6'0"; mfr CCI, Dwg. nos. 327-R-E-402, 327-R-E-403; consists of: E601, E602, P601, P602, W601A	Connects cabinet with receiver chassis during alignment and/or checking; bridges AC input, audio output and antenna input lines
W601A	Assemble from component parts	CABLE, SPECIAL PURPOSE, ELECTRICAL: total of 5 conductors; length of each conductor 5'7"; 2 conductors of JAN-C-76, Type SRIR wire, #22 stranded (7), with shielding braid and over-all outer vinylite jacket (shielding braid to be used as ground conductor); 2 conductors of JAN-C-76, Type SRIR wire, #18 stranded (7), grey color code; 1 conductor of RG-58 A/U coaxial cable, black; mfr CCI, Dwg. 327-R-E-402; p/o W601	Part of test cable W601
XC305	For replacement use SNSN N16-S-63515-4151	SOCKET, ELECTRON TUBE: 8 contacts, beryllium copper, silver-plated; octal; mica body; oval shape; over-all dim. 1 53/64" lg x 1 9/32" wide x 17/32" high, excluding terminals; 1 piece saddle, bottom mounting; 1 1/8" chassis hole required; two 5/32" mtg holes 1 1/2" C to C; per Spec. JAN-S-28A, Type TS101P01; used with C305	Receptacle for C305 electrolytic plug-in capacitor
XF301	N17-F-74266-9053	FUSEHOLDER: extractor post type; 15 amp, 250 v rating; accomodates one type 3AG glass cartridge fuse, 1/4" dia x 1 1/4" lg; black bakelite body; over-all dim. 1 11/16" lg x 11/16" dia, excluding terminal; 2 solder lug terminals; single hole mtg, 1/2" dia; bayonet type knob permits fuse removal with 1/4 turn; mfr CLF, Type B-342003; used with F301	Receptacle for AC fuse
XF302		Same as XF301; used with F302	Receptacle for AC fuse
XI401	N17-L-076773-5476	LIGHT, INDICATOR: miniature; plain white jewel, stovepipe shape; bayonet base, accomodates T-3 1/4, Type NE-51 lamp; assembly includes resistor for NE-51 lamp; rated at 125 volts; over-all dim. 2 7/32" lg max, including jewel and terminals x 11/16" dia; single hole mtg; bushing 11/16" dia—27 thread x 1/2" lg min; supplied with 1 hex nut and two washers; 2 solder lug terminals; per Spec. MIL-L-3661, MS90287, Type LH64PW5; used with I401	Receptacle for Type NE51 neon lamp

TABLE 8-2. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NUMBERS STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS
XV101	N16-S-62603-6702	SOCKET, ELECTRON TUBE: 7 contacts, beryllium copper, silver-plated; miniature; includes metal shock shield, brass, nickel plated, 0.800" dia x 5/8" lg; includes center shield, 5/32" dia; oval shape; over-all dim. excluding terminals, 1 3/32" lg x 0.800" wide x 27/32" high; mica body; one piece saddle, top mtg; 5/8" chassis hole required; two 1/8" mtg holes, 7/8" C to C; per Spec. JAN-S-28A, Type TS102P01; used with V101	Receptacle for V101 tube
XV102		Same as XV101; used with V102	Receptacle for V102 tube
XV103		Same as XV101; used with V103	Receptacle for V103 tube
XV104	N16-S-64063-6713	SOCKET, ELECTRON TUBE: 9 contacts, beryllium copper, silver plated; miniature; includes metal shock shield, brass, cadmium plated, 0.940" dia x 5/8" lg; includes center shield, 5/32" dia; oval shape; over-all dim. excluding terminals, 1 3/8" lg x 0.940" wide x 27/32" high; mica body; one piece saddle, top mtg; 3/4" chassis hole required; two 1/8" mtg holes, 1 1/8" C to C; per Spec. JAN-S-28A, Type TS103P01; used with V104	Receptacle for V104 tube
XV105		Same as XV104; used with V105	Receptacle for V105 tube
XV201		Same as XV101; used with V201	Receptacle for V201 tube
XV202		Same as XV101; used with V202	Receptacle for V202 tube
XV203		Same as XV101; used with V203	Receptacle for V203 tube
XV204		Same as XV101; used with V204	Receptacle for V204 tube
XV205		Same as XV101; used with V205	Receptacle for V205 tube
XV206		Same as XV104; used with V206	Receptacle for V206 tube
XV301		Same as XV101; used with V301	Receptacle for V301 tube
XV302		Same as XV101; used with V302	Receptacle for V302 tube
XY101	N16-S-54284-7281	SOCKET, CRYSTAL: two 0.050" dia pins accomodated, spaced 1/2" C to C; rectangular with rounded ends; over-all dim., excluding terminals 25/32" lg x 5/16" wide x 5/16" high; ceramic body; top screw mtg; mtg by one 1/8" hole, spaced midway between contacts; mfr CJA, Type 33302; used with Y101	Receptacle for Type CR-23/U 20 Mc crystal
XY102		Same as XY101; used with Y102	Receptacle for Type CR-23/U Frequency Determining Crystal
Y101	N16-C-98650-1034	CRYSTAL UNIT, QUARTZ: one crystal plate; nominal frequency 20 Mc; Type HC-6/U holder; two solid pins located on bottom of holder, 0.050" dia x 0.203" lg, spaced 0.486" C to C; rectangular body with rounded ends; metal case, hermetically sealed; over-all dim. 3/4" lg x 11/32" wide x 25/32" high, excluding terminals; contact pins fused in glass inserts; vibration resistant; frequency tolerance ±0.005% of nominal frequency over temperature range of —55° to +90° C; mfr CAIJ; per Spec. MIL-C-3098, Type CR-23/U; used with XY101	V104—20 Mc oscillator crystal

Y102		CRYSTAL UNIT, QUARTZ: one crystal plate; nominal frequency between 30.2-37.75 Mc; type HC-6/U holder; two solid pins located on bottom of holder, 0.050" dia x 0.203" lg, spaced 0.486" C to C; rectangular body with rounded ends; metal case, hermetically sealed; over-all dim. 3/4" lg x 11/32" wide x 25/32" hight, excluding terminals; contact pins fused in glass inserts; vibration resistant; frequency tolerance ±0.005% of nominal frequency over temperature range of —55° to +90° C; per Spec. MIL-C-3098, Type CR-23/U; used with XY102	V105 frequency determining crystal (crystal not supplied with receiver)
Z101	N17-T-81484-1301	COIL, RADIO FREQUENCY: two spaced windings, air wound; primary 1 turn no. 16 AWG tinned copper wire, secondary 3 2/3 turns no. 16 AWG tinned copper wire, tapped at 2 1/3 turns; frequency range 100-156 Mc (100 Mc —1% to 156 Mc +1%) shielded; shield can etched aluminum; over-all dim. 1 7/16" square x 1 22/32" high, excluding terminals and tuning screw; adjustable tuning with 4-23 μμf trimmer capacitor; screwdriver tuned; mtd by two spade bolts, no. 6-32 thread x 3/8" lg on 1 1/16" mtg centers; shield can retained by two no. 4-40 x 1/4" Phillips type captive screws; 6 miniature, hollow swaged terminals, silver plated located on bottom plate; approximate calibration settings in megacycles silk screened on top of shield can; mfr CCI, Dwg. nos. 327-R-E-311, 327-R-E-312, 327-R-E-315, 327-R-E-616; consists of: C105, C121, L101	Antenna input coil
Z102	N16-C-76215-5433	COIL, RADIO FREQUENCY: one spaced winding, air wound; secondary 3 2/3 turns #16 AWG tinned copper wire, tapped at 2 1/3 turns from capacitor terminal; frequency range 100-156 Mc (100 Mc —1% to 156 Mc +1%) shielded; shield can etched aluminum; over-all dim. 1 7/16" square x 1 23/32" high; excluding terminals and tuning swrew; adjustable tuning with trimmer capacitor 4-23 μμf and fixed 470 μμf button mica capacitor; screwdriver tuned; mtg by two spade bolts #6-32 thread x 3/8" lg on 1 1/16" mtg centers; shield can retained by two no. 4-40 x 1/ 4" Phillips type captive screws; 6 miniature hollow swaged terminals located on bottom; approximate calibration settings in Mc silk screened on top of shield can; mfr CCI, Dwg. nos. 327-R-E-312 and 327-R-E-324; consists of C122, C134, C146, L102	RF input to V101
Z103		COIL, RADIO FREQUENCY: one spaced winding, air wound; secondary 3 2/3 turns #16 AWG tinned copper wire, tapped at 2 1/3 turns from capacitor terminal; frequency range 100-156 Mc (100 Mc —1% to 156 Mc +1%); shielded; shield can etched aluminum; over-all dim. 1 7/16" square x 1 23/32" high; excluding terminals and tuning screw; adjustable tuning with trimmer capacitor 4-23 μμf and fixed 470 μμf button mica capacitor; screwdriver tuned; mtg by two spade bolts #6-32 thread x 3/8" lg on 1 1/16" mtg centers; shield can retained by two no. 4-40 x 1/4" Phillips type captive screws; 6 miniature hollow swaged terminals located on bottom; approximate calibration settings in Mc silk screened on top of shield can; mfr CCI, Dwg. No. 327-R-E-316; consists of C123, C136, L103	RF output V101
Z104		Same as Z103 except component parts consists of C124, C137, L104	RF input V102

TABLE 8-2. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NUMBERS STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS
Z105	N16-C-76197-9851	COIL, RADIO FREQUENCY: one spaced winding, air wound; secondary 2 turns #16 AWG tinned copper wire, tapped at 1/2 turn from capacitor terminal; frequency range 123-179 Mc; shielded; shield can etched aluminum; over-all dim 1 7/16" square x 1 23/32" high, excluding terminals and tuning screw; adjustable tuning with trimmer capacitor 4-23 $\mu\mu$f screwdriver tuned; screw; adjustable tuning with trimmer capacitor 4-23 $\mu\mu$f; screwdriver tuned; can retained by two no. 4-40 x 1/4" Phillips type captive screws; 6 miniature hollow swaged terminals located on bottom; approximate calibration settings in Mc silk screened on top of shield can; mfr CCI, Dwg. Nos. 327-R-E-313 and 327-R-E-317, consists of C125, L110	2nd coil of RF multiplier V105
Z106	N16-C-76197-9876	COIL, RADIO FREQUENCY: one spaced winding, air wound; secondary 2 turns #16 AWG tinned copper wire, tapped at 1/2 turn from capacitor terminal; frequency range 123-179 Mc shielded; shield can etched aluminum; over-all dim. 1 7/16" square x 1 23/32" high, excluding terminals and tuning screw; adjustable tuning with trimmer 4-23 $\mu\mu$f and a fixed 470 $\mu\mu$f mica button capacitor; screwdriver tuned; mtg by two spade bolts #6-32 thread x 3/8" lg on 1 1/16" mtg centers; shield can retained by two no. 4-40 x 1/4" Phillips type captive screws; 6 miniature hollow swaged terminals located on bottom; approximate calibration settings in Mc silk screened on top of shield can; mfr CCI, Dwg. Nos. 327-R-E-313 and 327-R-E-318, consists of C126, C139, L111	1st coil of RF multiplier V105
Z107	N16-C-76524-7301	COIL, RADIO FREQUENCY: one winding, single layer, close wound on glass base tubing, 1/2" OD x 3/4" high; 0.79 microhenries inductance; 7 1/2 turns #22 AWG copper wire, enameled; not tapped; frequency range 30.2-37.75 Mc, shielded; shield can etched aluminum; over-all dim. 1 7/16" square x 1 23/32" high, excluding terminals and tuning screw; air core; adjustable tuning with trimmer capacitor, 4-23 $\mu\mu$f; screwdriver tuned; mtg by two spade bolts #6-32 thread x 3/8" lg on 1 1/16" mtg centers; shield can retained by two no. 4-40 x 1/4" Phillips type captive screws; 6 miniature hollow swaged terminals located on bottom; approximate calibrations settings in Mc silk screened on top of shield can; mfr CCI, Dwg. Nos. 327-R-E-314 and 327-R-E-319; consists of C127, L112	V105 frequency determining oscillator transformer
Z108	N16-C-76532-3401	COIL, RADIO FREQUENCY: one winding, single layer, close wound on phenolic coil form, 3/8" OD x 1 17/64" high; 1.03 microhenries inductance; 8 turns #24 AWG copper wire, double nylon covered; not tapped: peak frequency 20 Mc; shielded; shield can etched aluminum; over-all dim 1 7/16" square x 1 23/32" high, excluding terminals and tuning screw; powdered iron core; adjustable tuning with iron core slug; screwdriver tuned; mtg by two #4-40 threaded rods on 1 3/8" mtg centers; shield can retained by 2 #4-40 thin nuts on threaded top end of support rods; 2 solder lug terminals, located on bottom plate; mfr CCI, Dwg. No. 327-R-E-322; consists of C120, L107	V104—20 Mc oscillator transformer

TABLE 8-3. CROSS REFERENCE PARTS LIST

JAN (OR AWS) DESIGNATION	KEY SYMBOL
JAN-1A	
JAN-5654	V101
JAN-5749	V103
JAN-6AU6WA	V201
JAN-6AV6	V205
JAN-6005/6AQ5W	V302
JAN-6201/12AT7WA	V104
JAN-C-5	
CM20B471K	C219
CM30B152K	C224
CM30B332K	C223
CM20C101J	C141
CM20C330J	C203
CM20C470J	C142
CM20C560J	C120
JAN-C-20A	
CC20CK010C	C128
CC20CK020C	C130
CC30CK030C	C105
JAN-C-25	
CP69B5EF503M	C220
JAN-C-62	
CE53F100R	C305
CE63C500G	C225
JAN-C-92	
CT1C025	C121
JAN-J-641	
JJ-034	J404
JAN-R-11	
RC20BF103K	R118
RC20BF104K	R109
RC20BF105K	R119
RC20BF150K	R125
RC20BF155K	R225
RC20BF221K	R111
RC20BF222K	R207
RC20BF223K	R108
RC20BF224K	R218
RC20BF225K	R304
RC20BF331K	R226
RC20BF333K	R220
RC20BF472K	R105
RC20BF473K	R106
RC20BF474K	R101
RC20BF821K	R122
RC20BF682K	R116
RC20BF683K	R215
RC30BF223K	R205
RC42BF331K	R306
JAN-R-94	
RV4TSA104A	R216
RV4ATS503E	R401
RV4ATS504C	R301
JAN-S-23	
ST42A	S201
ST52K	S401
JAN-S-28A	
TS101P01	XC305
TS101P01	XV101
TS102U01	E101
TS102U02	E103
TS102U03	E302
TS103P01	XV104

MIL DESIGNATION	KEY SYMBOL
MIL-C-71A	
UG-21-B/U	P501
UG-58-A/U	J501
UG-177/U	E501

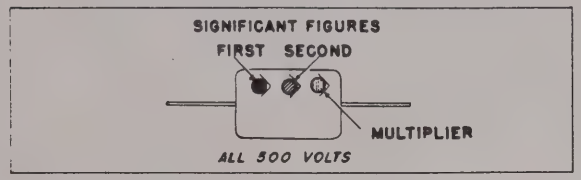
MIL TYPE DESIGNATION	KEY SYMBOL
MIL-C-3608	
UG-88/U	P301
UG-209/U	J101
MIL-C-3098	
CR-23/U	Y101
CR-23/U	Y102
MIL-C-5015	
AN-3102A-10SL-4P	J502
AN-3102A-10SL-3P	J503
AN-3106A-10SL-4S	P502
AN-3106A-10SL-3S	P503
MIL-C-10950A	
CB21VD471K	C134
CB21TW471M	C135
MIL-C-11015A	
FT-1000	C132
MIL-F-15160A	
FO2G1R00B	F301
MIL-L-3661	
LH64PW5	XI401
MIL-R-26B	
RW20G402	R307

STANDARD NAVY STOCK NUMBERS	KEY SYMBOL
G17-L-6806-130	I401
N16-A-39348-1018	AR201
N16-A-39380-1010	AR101
N16-A-39386-2501	AR301
N16-C-15368-5828	C128
N16-C-15432-5828	C130
N16-C-15528-5828	C105
N16-C-18659-8953	C132
N16-C-18661-1302	C101

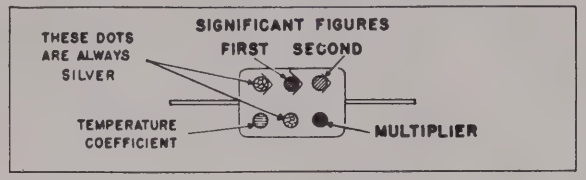
STANDARD NAVY STOCK NUMBERS	KEY SYMBOL	STANDARD NAVY STOCK NUMBERS	KEY SYMBOL	STANDARD NAVY STOCK NUMBERS	KEY SYMBOL
N16-C-18983-9881	C205	N16-R-49922-0811	R113	N17-C-70319-1800	J502
N16-C-19140-9551	C108	N16-R-49967-0811	R201	N17-C-70326-9330	J503
N16-C-19958-9809	C225	N16-R-50012-0811	R207	N17-C-70326-9330	P503
N16-C-22489-5051	C305	N16-R-50129-0811	R105	N17-C-71408-3521	P301
N16-C-27181-4401	C203	N16-R-50201-0811	R116	N17-C-71419-9699	P501
N16-C-27577-1401	C142	N16-R-50282-0811	R118	N17-C-72595-1800	P502
N16-C-27761-7201	C120	N16-R-50372-0811	R108	N17-C-73108-1267	J101
N16-C-28553-1201	C141	N16-R-50373-0231	R205	N17-C-73108-5906	J501
N16-C-30114-4276	C219	N16-R-50417-0811	R220	N17-C-73285-6012	J504
N16-C-30119-5075	C135	N16-R-50480-0811	R106	N17-C-77323-3220	J401
N16-C-30172-4410	C134	N16-R-50552-0811	R215	N17-C-73569-8951	J302
N16-C-31512-4564	C224	N16-R-50633-0811	R109	N17-C-73615-4692	J102
N16-C-31908-1564	C303	N16-R-50714-0811	R218	N17-F-74266-9053	XF301
N16-C-32250-9764	C223	N16-R-50822-0811	R101	N17-J-39248-4418	J404
N16-C-54402-7003	C220	N16-R-50975-0811	R119	N17-L-076773-5476	XI401
N16-C-58836-5282	C121	N16-R-51020-0811	R225	N17-S-250051-153	E501
N16-C-72745-1875	L503	N16-R-51065-0811	R304	N17-S-70412-4406	S201
N16-C-72911-7481	L113	N16-R-51326-811	R237	N17-S-72828-2605	S401
N16-C-74484-9020	L501	N16-R-87679-3469	R216	N17-T-67809-7962	T201
N16-C-76197-9851	Z105	N16-S-34516-6514	E104	N17-T-68220-1442	T101
N16-C-76197-9876	Z106	N16-S-34520-3864	E101	N17-T-68220-1443	T102
N16-C-76215-5433	Z102	N16-S-34557-8351	E103	N17-T-73688-3591	T301
N16-C-76524-7301	Z107	N16-S-34607-6039	E302	N17-T-81484-1301	Z101
N16-C-76532-3401	Z108	N16-S-54284-7281	XY101		
N16-F-16302-80	F301	N16-S-62603-6702	XV101		
N16-K-88179-4482	R301	N16-S-63515-4151	XC305		
N16-R-29236-8021	L301	N16-S-64063-6713	XV104		
N16-R-49283-0811	R125	N16-T-56203-53	V201		
N16-R-49661-0811	R111	N16-T-56203-60	V205		
N16-R-49706-0811	R226	N16-T-58240-14	V104		
N16-R-49707-511	R306	N16-T-64535-9171	T302		
N16-R-49769-0811	R103	N16-T-75654	V101		
N16-R-49841-0811	R212	N16-T-75749	V103		
N16-R-49877-0811	R122	N16-T-76005	V302		

CAPACITOR COLOR CODES

RMA 3-DOT CODE - FOR MICA-DIELECTRIC CAPACITORS



JAN 6-DOT CODE - FOR PAPER-DIELECTRIC CAPACITORS



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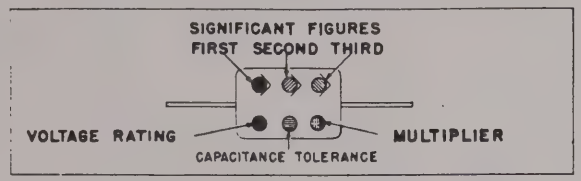

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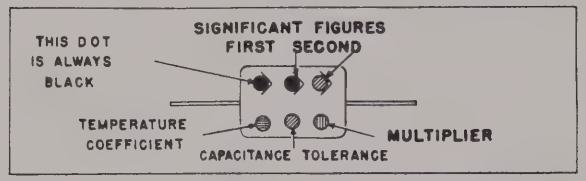
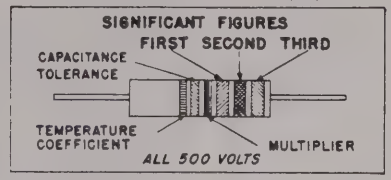
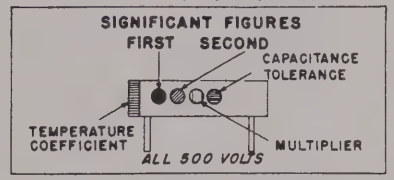


RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS

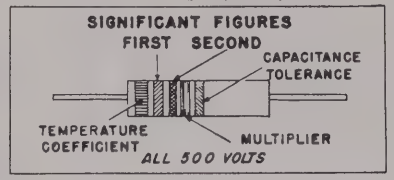


JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS

RADIAL TYPE NON-INSULATED



AXIAL TYPE INSULATED



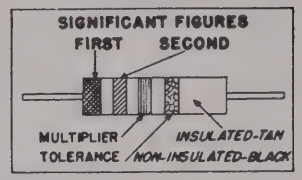
RMA: RADIO MANUFACTURERS ASSOCIATION
JAN: JOINT ARMY-NAVY

RESISTORS		CAPACITORS						
				MULTIPLIER				
TOLERANCE	MULTIPLIER	SIGNIFICANT FIGURE	COLOR	RMA MICA AND CERAMIC-DIELECTRIC	JAN MICA AND PAPER-DIELECTRIC	JAN CERAMIC DIELECTRIC	VOLTAGE RATING	TEMPERATURE COEFFICIENT
	1	0	BLACK	1	1	1		A
	10	1	BROWN	10	10	10	100	B
	100	2	RED	100	100	100	200	C
	1,000	3	ORANGE	1,000	1,000	1,000	300	D
	10,000	4	YELLOW	10,000			400	E
	100,000	5	GREEN	100,000			500	F
	1,000,000	6	BLUE	1,000,000			600	G
	10,000,000	7	VIOLET	10,000,000			700	
	100,000,000	8	GRAY	100,000,000		0.01	800	
	1,000,000,000	9	WHITE	1,000,000,000		0.1	900	
5	0.1		GOLD	0.1	0.1		1000	
10	0.01		SILVER	0.01			2000	
20			NO COLOR				500	

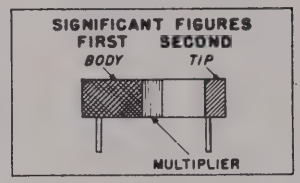
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE

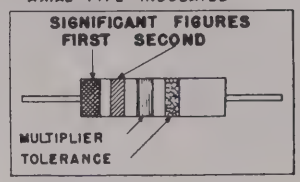


RADIAL TYPE



JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE INSULATED



RADIAL TYPE NON-INSULATED

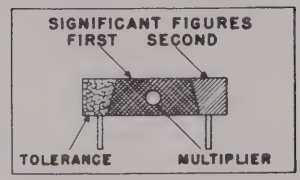


TABLE 8-4. APPLICABLE COLOR CODES AND OTHER MISCELLANEOUS DATA

TABLE 8-5. LIST OF MANUFACTURERS

CODE NUMBER	PREFIX	NAME	ADDRESS
1	CPH	American Phenolic Corp.	1830 South 54th Ave., Chicago 50, Ill.
2	CED	Cannon Electric Development Co.	3291 Humboldt St., Los Angeles, Calif.
3	CBN	Central Radio Laboratory	900 E. Keefe Ave., Milwaukee, Wis.
4	CTC	Chicago Telephone Supply Co.	Elkhart, Ind.
5	CCI	Communications Co., Inc.	300 Greco Ave., Coral Gables, Fla.
6	CER	Erie Resistor Corp.	644 W. 12th St., Erie, Pa.
7	CG	General Electric Co.	1 River Road, Schenectady, N. Y.
8	CBDW	Grayhill	1 No. Pusaski Road, Chicago, Ill.
9	CHD	Hardwick-Hindle, Inc.	65 Johnson St., Newark, N. J.
10	CIR	International Resistance Co.	401 N. Broad St., Philadelphia, Pa.
11	CLF	Littlefuse, Inc.	1865 Miner St., Desplaines, Ill.
12	CJA	Millen, James, Mfg. Co., Inc.	150 Exchange St., Malden, Mass.
13	CAIJ	Pan-Electronics, Labs., Inc.	498-500 Spring St., Atlanta, Ga.
14	CBJS	Radio Materials Corp.	202 West Main St., Attica, Ind.
15	CBGB	Sarkes Tarzian	537 South Walnut St., Bloomington, Ind.
16	CADF	Standard Transformer Corp.	1500 N. Halstead, Chicago, Ill.

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